THE

ELECTRICAL REVIEW.

VOL. XLIX. JULY 12, 1901. No. 1,233.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1901 Edition

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THE TEACHINGS OF THE GERMAN VISIT OF THE I.E.E.

THE members of the Institution of Electrical Engineers who took part in the tour which came to an end on Friday last, are now, no doubt, digesting the lessons which their German friends have taught them.

By no means the least of these is the splendid example of unstinted hospitality and hearty welcome set before them by their hosts; the visit would be memorable for this cause alone. Apparently regardless of expense, our friends spared absolutely no effort to enhance the physical comfort and enjoyment of their guests, while the mental feast which they had set out was equally profuse and excellent.

The speeches made on both sides were of the most cordial and friendly character; not the least noteworthy feature was the graceful acknowledgment, couched in most complimentary terms, and repeated more than once, that the art of mechanical engineering, of which electrical engineering is the offspring, was developed by the British people, and that the Germans were their pupils. "Electrical Technology," said Herr Rathenau, "is the child of mechanical engineering, which we learnt in your country—in London, Manchester, Leeds, Birmingham, Glasgow, &c., and from J. Penn & Sons, Neilson, Reid & Co., Armstrong, Whitworth and Co., Harland & Wolff, &c. We have to thank your engineers for pioneer work in locomotive and ship construction, tools, spinning, weaving, and other machines too numerous to mention; if you see the exertions of Germany in these branches, and large works with hundreds and thousands of men, do Germany the justice to admit that the masters may well be proud of their scholars' industry."

Herr Rathenau was right; the masters may well be proud of their pupils—but be it ever remembered that *we* are not the masters; we are the pupils of the same great teachers, with far better opportunities of learning from them. Let us then strive to emulate the Germans in the practical way in which they have studied and applied their studies. Without going so far as to say that the tables are turned, we must at least admit that the British visitors found that they had many things to learn from their fellow-pupils, and we sincerely trust that, thanks to the generosity of their hosts, they *have* learnt them.

Apart from minor details, there are certain broad lessons which should be laid to heart by every member of the party. In the first place, the consideration exercised by the employers for the health and comfort of their workmen cannot be too strongly emphasised. Marvellous cleanliness, perfect sanitation, abundant provision for personal ablutions, baths, lockers for the men's belongings, dining rooms—sometimes provided with buffets where cooked food can be obtained at nominal rates—all these are things which in the majority of British factories are unknown and unthought of. If the leaders of the trades unions could but

have been induced to agitate for such things as these, instead of for their greater power and glory, how much better would have been the lot of the British workman to-day! However, such reforms ought to come from above; the employers should themselves take steps to remedy the present deplorable conditions under which the men are expected to work. Perhaps if the works were made fit places to live in we should hear less of the eight-hour day and less of shirking duty; the last is but an imitation of the employers' neglect of their duty to the men.

To take another point—the perfect discipline and orderly character of the men cannot but be noticed. These we are bound to ascribe to the military conscription which obtains in Germany. There every man is a soldier, and has, therefore, learnt the necessity of obedience—without servility—and the importance of organisation when large numbers of men and things have to be dealt with. It is very true that a sense of discipline is, to a certain extent, inborn in the British race, and that excess of discipline leads to the loss of personal initiative; yet one cannot but feel that to trust to the natural gifts of the race is a somewhat unsatisfactory and negative policy. Should we not rather be up and doing, instead of sitting still and saying we are born great?

Coming now to the higher grades, it is noticeable that while the members of the staff of the German works are largely specialists, confining their attention to some particular subject, they are *well versed* in that subject. Practically all of them have passed through one or other of the excellent technical schools provided for their instruction at the joint expense of the State, the local manufacturers, and themselves, and are fully conversant with the principles which underlie the apparatus or processes in their charge. We need not say that there is a strong contrast between these conditions and those which rule in this country. Our colleges are too few, too expensive, too academical.

Further still, and more deeply rooted, there is the absurd system of so-called education which prevails in our elementary schools, by which the mind is crammed with facts, but is never taught to *think*. Of what earthly use are the facts, if the power to think is lacking? But we must pass on now—we shall deal more fully with this question later.

Lastly, we have to speak of one remarkable feature of the German works and stations which cannot fail to strike an observer—the immense and lavish outlay of capital upon them, especially in the case of those of recent date. Now, while we regard the outlay upon cleanliness and sanitation as well spent, we cannot see our way to approve of the, to our mind, prodigal expenditure upon buildings, in regard to magnitude, construction and ornamentation. It must be borne in mind that dividends have to be paid somehow upon all this dead capital, and these are times of severe competition, combined with—in Germany—slackness of trade. In this respect a prudent course is certainly the wiser one to adopt. British manufacturers are apt, indeed, to carry prudence too far, refusing to extend their works to meet the growing trade; but we cannot help thinking that our German friends have gone to the opposite extreme.

There are doubtless many other lessons to be drawn from this memorable tour; we have merely indicated some which appear to us to be of the first importance. It is, however, highly desirable that the fruits of the visit should be as widely disseminated as possible, and we shall therefore welcome contributions on the subject from those who took part in it.

The Transparency of Bodies to X Rays.—Some recent experiments by M. Benoist on this subject show that the views hitherto accepted require some modification. He finds, firstly, that the specific opacity of a body to X rays appears to be independent of its physical state; for instance, it is the same for water as for ice, and is independent of the temperature, &c. Secondly, the specific opacity seems to be independent of the mode of atomic grouping of the body, that is, of crystalline form, allotropic states, &c. It is the same, for instance, for anhydrous alumina and corundum; for the different forms of carbon, crystalline and amorphous; for yellow and red phosphorus, &c.; also for all isomeric organic compounds. Thirdly, it appears to be independent of the state of freedom of the atoms, and the transparence of a mechanical mixture or chemical combination can be calculated from that of its constituents. The specific opacity for X rays measured under determined conditions may be considered as a property of bodies allied to that of atomic weight, atomic calorific capacity, &c. As it depends entirely on the nature of the atoms, M. Benoist made experiments to determine the co-relation of these quantities. He found this could always be expressed by a curve of definite form resembling somewhat the form of a hyperbola. The form of the curve depends also on the kind of X rays used. With rays of maximum penetrative power, the specific opacity is nearly directly proportional to the atomic weight.

Subways.—A recent report of the Improvements Committee of the L.C.C. referred to the resolutions which were adopted at a conference of London local authorities which was held some time ago. One of the resolutions expressed the opinion that subways should be constructed in all new leading thoroughfares for the accommodation of water and gas mains, pipes, &c., and a second that the time had arrived for concerted action on the part of the local authorities in London "to remedy the inconvenience, annoyance, loss of time and money now caused by the operations of the gas, water, telephone, and electric lighting companies" in laying down, renewing, and repairing their services. The Committee stated that the question of subways, as suggested by the conference, affirms a principle which has guided them for some years, subways being proposed where the advantage would be commensurate with the cost involved. As an example of the practice, the report refers to the fact that there will be a complete system of subways for water and gas mains, pipes, wires, &c., in the new street from Holborn to the Strand, in Southampton Row, in the new crescent road, on the north side of the Strand from Wellington Street to the Law Courts, in the northern and southern approaches to the Tower Bridge, and in the Long Lane and Tabard Street improvement. The powers of the Council to attain the object of the second of the resolutions are limited to the construction of subways in connection with new streets, and to the application of the London County Council (Subways) Act, 1893, for compelling the owners of disturbed pipes and wires to use the subways. It will be evident that it has been the practice, as far as possible, to follow the course suggested in the resolutions passed at the conference, and the Council decided to agree with the view of the Committee that no useful purpose could be served by any further action being taken in the matter.

Observatories and Tramways.—We read in *Nature* that a new magnetic observatory is being established just now in France. It is situated at a distance of only 30 miles from Parc St. Maur, where records have been rendered impossible, electrical railways using the earth for return currents having been laid in almost every direction. The new observatory is situated in the small parish of Villepreux, in a district occupied by farms, cornfields and woods. The authorisation was granted by the Government only when the railway companies had paid to the National Treasury a sum of £1,200, sufficient for paying all the expenses of the new building. These have been greatly diminished because the land covers about 10 acres belonging to the Government, and some old buildings without any artistic value can be demolished for procuring the stones required in order to construct the magnetic pavilions and a house for the observer. M. Moureau will continue to reside at Parc St. Maur, and the new observatory will be considered as an accessory to the old one.

EXPERIMENTS IN WIRELESS TELEGRAPHY WITH THE GUARINI AUTOMATIC REPEATER.

BRUSSELS—MECHLIN—ANTWERP.

(*Concluded from page* 1115, *Vol.* 48.)

THIS opinion was modified by the following experiments: They connected the Mechlin antenna, which is about 70 metres high, directly with one electrode of the coherer, the other electrode being connected to earth. Every time they broke or re-established the connection either between the antenna and the coherer (fig. 29), or between the latter and the earth (fig. 30), they obtained a deviation at the galvanometer. MM. Guarini and Poncelet attribute this fact to the atmospheric electricity passing through the

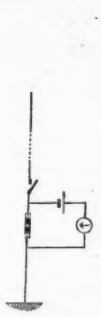


FIG. 29.

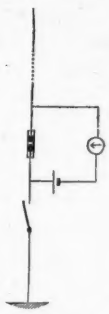
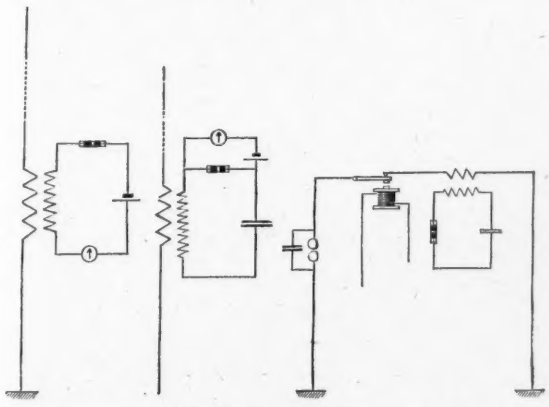


FIG. 30.

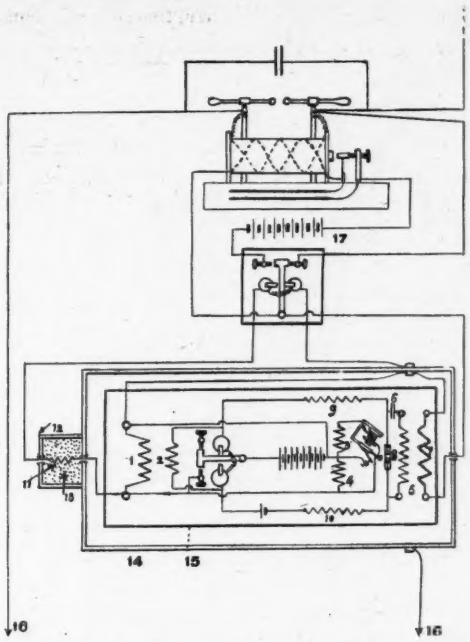
antenna; when connection was either broken or established, extra currents were produced which affected the coherer. They then connected the antenna to one terminal of the primary of an induction coil, the other terminal being connected to earth; into the secondary circuit were introduced a very sensitive Blondel coherer, a battery element, and a galvanometer (fig. 31). The needle of the galvanometer showed a constant deviation. Lastly, they put a condenser in shunt on the coherer (fig. 32), and then no longer observed the slightest deviation of the needle of the galvanometer, even when breaking or establishing connection with the antenna or the earth. It was this arrangement that the experimentalists adopted at the repeater, together with a condenser in shunt on the oscillator in order to diminish the length of spark and consequently the travel of the interrupting electro-magnet (fig. 33).



FIGS. 31, 32 AND 33.

The Guarini repeating apparatus used at Mechlin is therefore the one with a single antenna connected with the receiver, and also with the transmitter, with an arrangement for interrupting communication between the antenna and the receiver when it is working as the transmitting antenna.

M. Guarini has introduced a second relay. The relay which he puts in circuit with the coherer is extremely sensitive. Now in such a relay the surface of contact is only a fraction of a millimetre. It can only carry a maximum current of $\frac{4}{10}$ of an ampere under a pressure of 30 volts, whereas to work a 25-centimetre spark coil, he used in his experiments 3 amperes. He effected the interruption between the antenna that acts upon the coherer and the oscillator, by means of a relay bringing into action the strong current working the coil. Instead of being



1, 2, 3, 4, Shunts; 5, Transformer; 6, Condenser; 7, 0·25 ohms; 8, 11·000 ohms; 9, 10, 11, Self-induction coils, 40 ohms, 35 henrys; 12 and 14, Iron box; 13, Corrugated tin; 15, Board on which apparatus is mounted; 16, Earth.

FIG. 34.

connected directly with the coherer it ends at the earth passing through the primary of a little transformer, with the object of raising the pressure in the circuit of the coherer.

The condenser introduced into the circuit of secondary, self-induction coil, battery, and relay, plays a double part: it interrupts the continuity of the circuit and modifies its capacity. It was necessary, says M. Guarini, to take very great precautions, and to use all kinds of protection to ensure the good working of the apparatus. Thus, the coherer is enclosed in a metal case; a self-induction coil

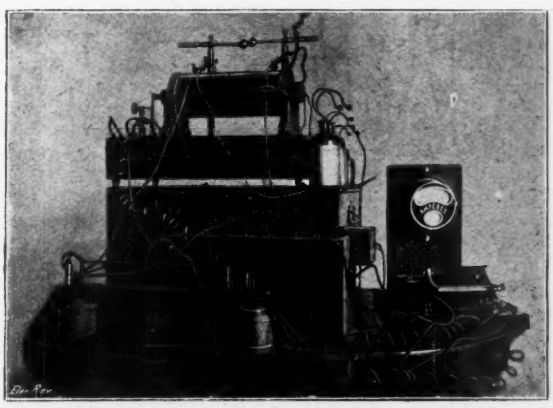
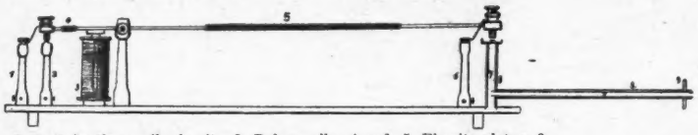


FIG. 35.

also contained in a little iron box and encased in corrugated tin connected to earth protects one of the connecting wires of the bobbin of the second relay, whilst the other is connected with the box and the earth. The second relay itself is placed outside the iron box, as the breaking spark of the circuit of the bobbin outside the part of the antenna connected with the oscillator, is sufficient, in the contrary

case, not only to affect a sensitive coherer, but practically to render it useless.

The second relay, and the part of the antenna connected with the primary of the transformer, were shielded and protected in various ways (fig. 36). Thus the armature of this relay was divided into three absolutely distinct parts, separated from one another by ebonite plates; one part for the strong current of the coil, one part constituting the armature of the core, and a third part for the interruption of the antenna.



1, 2, Induction coil circuit; 3, Relay coil; 4 and 5, Ebonite plates; 6, Antenna joined to oscillator; 7, Antenna joined to transformer primary; 8, Iron tube (earthed); 9, Iron plate holding tube to box.

Fig. 36.

The part of the antenna connected with the coherer by the transformer is first insulated, and then enclosed in an iron tube connected to earth. M. Guarini observed that a leaden pipe, with a thickness of even 2 mm. was permeable to the electric radiations, so that the coherer was affected. For the interrupter, instead of a single contact, M. Guarini used three contacts (fig. 37) arranged in such a manner that the total interruption should be equal to the sum of the partial interruptions.

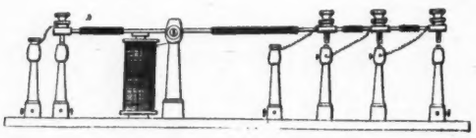
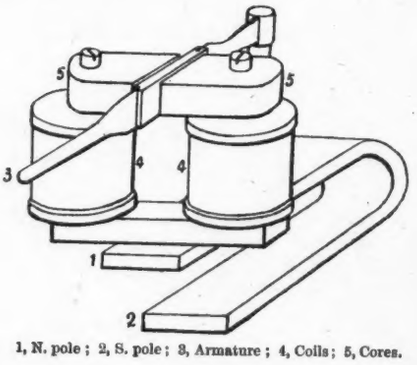


Fig. 37.

The relay employed is of the Siemens type. It only differs from it (fig. 38) in the fact that the north pole is connected with the cores, but the south pole is magnetically insulated from the armature. The sensibility of this relay is $\frac{1}{200}$th of an ampere. The coherer also has a special characteristic. It is thought that these instruments, which are certainly somewhat delicate when one is not very familar with them, are untrustworthy. The one used at Mechlin is extremely sensitive and sure in its working.

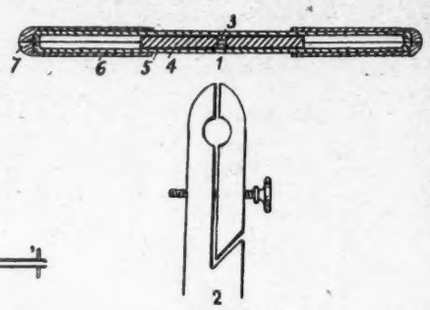


1, N. pole; 2, S. pole; 3, Armature; 4, Coils; 5, Cores.

Fig. 38.

It is known that the sensibility of a coherer increases with the pressure and the quantity of filings and diminishes with the coarseness of the latter and the extent to which the metal used is capable of being oxidised. Therefore a coherer has been designed with rather fine filings, and confined to a space of about half a millimetre in small quantity.

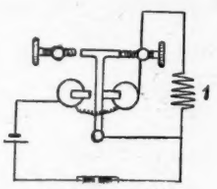
The coherer used by M. Guarini, and which gave him complete satisfaction, fulfilling best, according to him, the requirements of practice, only differs from the previous ones in that the space between the metal electrodes—1 mm.—is filled with very coarse filings of nickel with traces of silver, and a vacuum is formed in the tube. M. Guarini substituted for the wires, which are easily broken, copper cylinders, which could be slipped into special sleeves (fig. 39).



1, Coherer with metallic sleeve; 2, Sleeve; 3, Metal filings; 4, Metal cylinder; 5, Glass tube; 6, Metallic sleeve; 7, Platinum wire joined to 6.

Fig. 39.

Moreover, it is a fact well known to those interested in wireless telegraphy that decohesion is easier and more sure when the current passing through the coherer is excessively weak.



1, resistance of 2,000 w.

Fig. 40.

Instead of effecting an interruption, M. Guarini makes a special arrangement so that the relay starts with the current passing through a total resistance of 1,100 ohms, but when

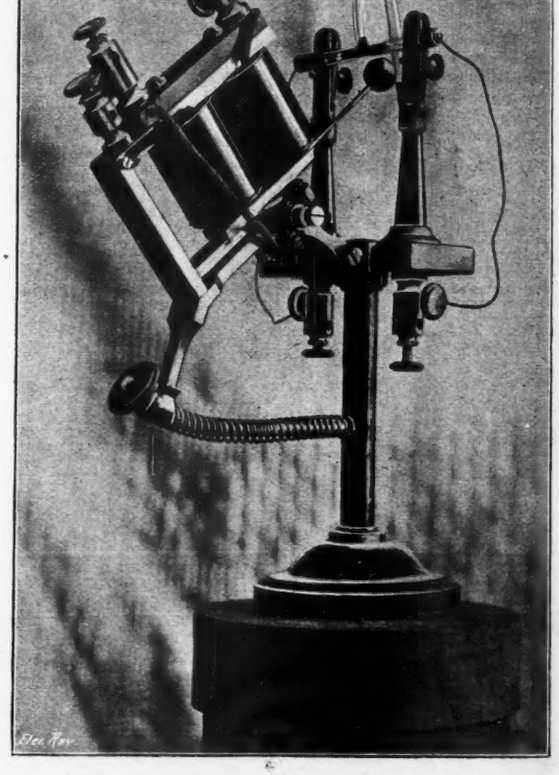


Fig. 41.

the striker gives the blow that decoheres the coherer, a supplementary resistance of 2,000 ohms is added

to the circuit of the coherer (fig. 40). Thus very slight strokes are sufficient for the decohesion.

The striker (fig. 41) is worthy of mention on account of its simplicity and the facility with which it is regulated.

The repeater worked in a manner that was absolutely satisfactory and automatic. On the day when the repeater was tried for ordinary telegraphy the problem of electric telegraphy to any distance was solved. It will be the same with wireless telegraphy; we shall only require to instal a suitable number of repeaters in order to communicate to any distance.

We may hope that fresh fields are opening up for overland wireless telegraphy, especially as regards Colonial and military applications.

THE TREATMENT OF LUPUS BY THE ARC LIGHT.

In the treatment of skin diseases, and particularly of lupus, electro-medical science is to-day being most successfully applied.

As will have been gathered from some letters which were recently printed in these columns, the comparative virtues of Röntgen rays and electric light for the treatment of lupus form a subject about which medical men are not quite in agreement. Both of these methods ought to appeal to our general sensibilities, for they are so thoroughly humane, and both are rendered possible by some of the most recent advances of electrical science.

It is to Prof. Finsen, of Copenhagen, that the world is indebted for the discovery that light contains bactericidal properties, and we propose to note what led up to the discovery, and to describe its application.

When the Professor first experimented with light he found that the chemical rays, namely, the blue, violet and ultra-violet, were capable of causing inflammation to healthy skin, so that if he were able to exclude these rays from light, he thought in some measure to lessen the intensity of the inflammation so as to do away with suppuration. This has been done most effectually, as in the case of small-pox. The patient is placed in a room which has in the windows an apparatus which prevents the chemical rays from entering, and only allows the heat rays to pass through.

Figs. 1, 2 and 3.

Dr. Finsen then turned his thoughts to the other side of the question. Knowing already that the chemical rays were capable of causing inflammation in the skin, he experimented to see if the rays, when concentrated, would prove bactericidal, and to what extent. We know that these experiments were successful, and the Doctor has made for himself a name that will ever live in the annals of history. Five years ago he started an Institute in Copenhagen to treat lupus.

We may mention that the disease is a tubercular one, and although of many kinds, can be divided into two classes:—

1. *Lupus Vulgaris.*—Nearly 1,000 of these cases have been treated, and with great success, some cures being so perfect that scarcely any trace of a scar can be seen.

2. *Lupus Erythematosus.*—This kind is uncommon, and is difficult to cure, but not impossible. It takes longer time than *lupus vulgaris*.

Sunlight has been used in the summer, and electric arc lamps in the winter; but doctors now believe the lamps to be the more powerful and penetrating in their rays; therefore the sunlight is only used for patients who have had a great deal of treatment, as that light does not cause such a severe reaction.

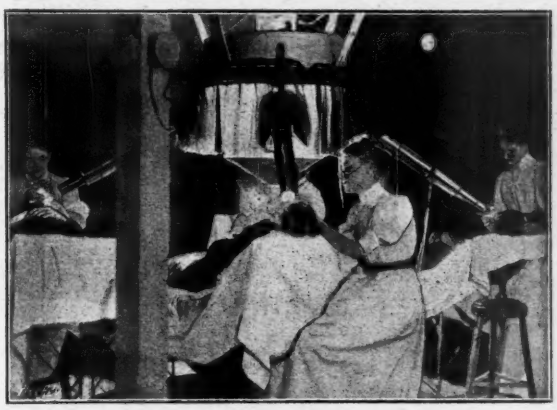


Fig. 4.

The apparatus used for the concentration of the sunlight is a glass lens composed of a plain glass, and a curved one framed in a brass ring. This lens is hollow, and is filled with a weak ammoniacal solution of copper sulphate, thus making the lens a bright blue. The reason for this is that the water absorbs the ultra red rays, and the blue absorbs most of the red and yellow rays. These three rays are the heat rays, and have no power to kill the bacteria, while the chemical rays pass through, and are very little weakened thereby (see fig. 1).

There are five arc lamps of different strengths. Lamps Nos. 1 and 2 are used with 80 amperes and 49 volts; Nos. 3 and 4 = 60 amperes and 49 volts; and No. 5 = 50 amperes and 48 volts.

Each lamp has four metal tubes, giving the appearance of telescopes, and these are fixed at the angle of 45°, and are for the concentration of the light. They each contain four lenses of quartz. This rock crystal is used in preference to glass, because it allows the ultra-violet rays of shortest wave-length to pass through easily, whereas glass does not; and it also helps to absorb some of the heat rays. The ultra-violet rays are especially effectual in destroying the bacteria. It is not necessary, however, for lenses concentrating sunlight to be of quartz, as the ultra-violet rays of that light are of much longer wave-length, and therefore can pass through glass. The light passes down these brass tubes, and in order that most of the heat rays shall be absorbed before the light reaches the patient the lower part of the tube is filled with distilled water, and to prevent this water becoming too hot by the absorption, ordinary cold water is continually running through a metal mantle which covers this end of

the tube. Even after this is done it is found that the light still contains too many heat rays, and is therefore too hot to be applied to the skin without burning. This, however, is remedied by the use of a little instrument consisting of a plate of quartz and a plano-convex lens of quartz, which are framed together in a conical brass ring. Fig. 2 shows that it has four arms, to which are fixed pieces of elastic, and with these it is tied upon the spot to be treated with such pressure that it makes the skin anæmic. It has been found that when the blood is so pressed away from the spot, the light is much more beneficial. This little instrument is hollow, and the same water that passes through the mantle of the brass tube now passes down small india-rubber tubes through this little lens and then out to waste. This little apparatus is also used in cooling the sunlight.

Another little instrument, which is used when treating the gums in the mouth, is of the same principle as the other, but it is much smaller and has a long handle, as shown in fig. 3.

About 150 patients are treated every day at Copenhagen, and all they have to do while under treatment is to lie quite still for one hour and a quarter. Each one is attended by a nurse to see that the light is always on the right spot. These nurses have to wear dark glasses to protect their eyes. The treatment, which takes a long time, is sometimes said to be a painless one, but that is not so, as the light makes the skin very inflamed and tender, but cooling ointment is applied on lint after each *séance*. It has long been seen that surgical operations, transplantations, &c., cannot master the disease. In some cases the operations render temporary benefit, but the disease always appears again on the edge, and therefore making a larger surface. The light cure is quite effectual.

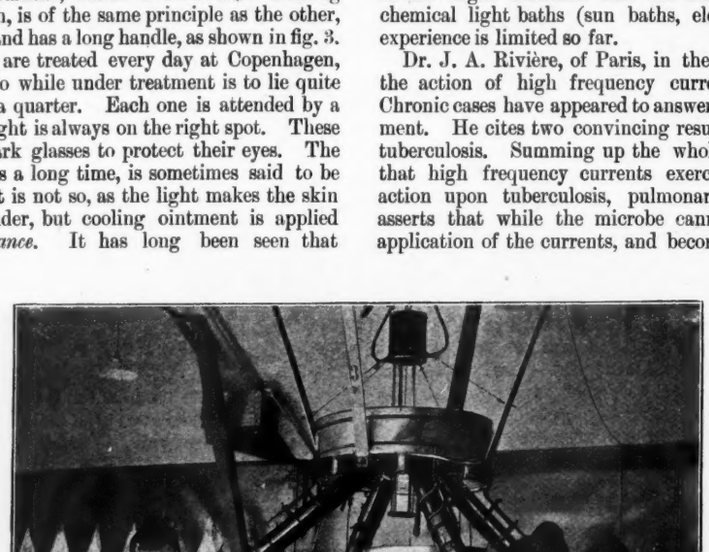


Fig. 5.

In a very short time the treatment will be removed to the new Institute, a much larger building; more lamps will then be added, so that it will be able to give even more help to suffering humanity in the future that it has done in the past.

For the introduction of Finsen light cure into this country it is a pleasure to express our admiration of the kindly and practical sympathy displayed by our most gracious Queen Alexandra, who, as the Princess of Wales, presented a set of light cure apparatus to the London hospital. By thus taking the initiative, Royalty led other hospitals to give the system a trial. We learn that at the London Hospital over 100 cases of lupus are treated daily by Finsen light.

Those among our readers who may wish to pursue their study of the light cure treatment a little further will do well to turn back their files of the Electrical Review and re-peruse an article on "Phototherapeutics, or the Light Cure," by Dr. W. S. Hedley (Vol. 45, September 29th, 1899, p. 509).

We find in the July issue of the *Journal of Physical Therapeutics*, of which Dr. Hedley is editor for the time being, and Dr. Margaret Cleaves, of New York, the American editor, several articles of interest in connection with the subject of light treatment. One of these is a translation of a contribution to a Continental journal by Dr. Finsen, in which the following conclusions are arrived at :—

1. I have confirmed the results of Wiedmark's researches on the action of light upon the skin, and further proved that the visible chemical rays also have the power to produce specific photochemical inflammation of the skin.

2. I have shown that in the electric light the strongest bactericidal power resides in the ultra-violet rays, and as a practical conclusion, it follows that quartz lenses ought exclusively to be used in electric light concentrating apparatus; and this alteration (from glass lenses) has immensely advanced the treatment with concentrated light.

3. I have pointed out that the dilatation of the cutaneous vessels produced by the chemical (ultra-violet) rays is of considerable duration, and it has even been possible to show this about half a year after the light's action.

4. Comparison of the different factors acting on the skin has shown that the normal reddish colour which the skin acquires when uncovered seems, if not exclusively, certainly for the most part, to be produced by the chemical rays; its occurrence seems to be retarded by heat and promoted by cold.

His observations indicate a great advance in the study of physiological action of light upon the skin. We read also that Dr. Finsen has been experimenting for some time past at the Light Institute with the therapeutic use of photochemical light baths (sun baths, electric light baths), but experience is limited so far.

Dr. J. A. Rivière, of Paris, in the same journal, discusses the action of high frequency currents upon tuberculosis. Chronic cases have appeared to answer best to electrical treatment. He cites two convincing results obtained in localised tuberculosis. Summing up the whole subject, he concludes that high frequency currents exercise a certain curative action upon tuberculosis, pulmonary and localised. He asserts that while the microbe cannot resist the repeated application of the currents, and becomes weaker, the human organism becomes strengthened. Dr. Rivière is under the impression that these two localisations of tuberculosis ought to be materially influenced for the better by the effluve, monopolar or bipolar, of the Oudin resonator (Rochefort model) or of the new d'Arsonval transformer (Gaiffe model).

In the same issue of *Physical Therapeutics* we find a valuable contribution by Dr. Margaret Cleaves bearing on the use of electric light treatment, entitled "The Electric Arc: Its Physics, Physiologic Action, Therapeutics, and Arrangement of Mechanisms." For light baths, the writer says that the electric arc, by reason of its physical properties, offers advantages not possessed in the same degree by any other source of light. It is stated that the best arrangement of light mechanisms for general applications is that which brings the patient as near to the source of light as the calorific rays will permit, where the intensity of the radiant energy, or incident energy per square inch, is great, as well as an arrangement that will permit of entire disrobing, and a position in the bath compatible with perfect repose and comfort, and further, which will also allow the fullest influence of the ozone generated during the action of the arcs, and with which the air becomes charged. A focussing arc should always be used in preference to a non-focussing arc, for when the diverging rays of light are condensed in a parallel beam, the intensity is constant along the beam, instead of continually diminishing with the square of the distance, as when radiating into space. Dr. Cleaves described a cabinet in which these conditions are best met when it is only desired to treat a single patient at a time. Where, however, a number are to be treated simultaneously, a room such as is used by Finsen becomes necessary. The writer continues :—

"As to the mechanisms for localisation of high frequency waves of radiant energy in skin diseases, two forms of

apparatus are in use which meet the conditions. For the first, both as to arrangement and method, all honour belongs to Finsen."

No better device has been offered, however, unless it be that of MM. Lortet and Genoud, of Lyons, France. This Dr. Cleaves has not yet had an opportunity of testing, but its simplicity of construction, as well as comparative inexpensiveness, make strong appeal for its practical value.

With their apparatus MM. Lortet and Genoud have found that an exposure of from 15 to 20 minutes suffices against 1¼ hours with the Finsen tube. It is observed that if this be true, it is due to the securing a residual beam of much greater total energy than is obtained from a tube with condensing lenses of quartz. This residual beam, to be properly effective, must possess the greatest possible number of high frequency waves of considerable amplitude, a beam not only of high intrinsic energy, but greater total energy. As the amount of work accomplished always depends upon the amount of energy expended, it follows that a shorter exposure should give equally good, if not better results. The effect desired in lupus and carcinoma, for example, must be produced by the maximum of chemical activity, which means a maximum intensity of the very high frequencies.

The cost of the Lortet-Genoud apparatus is said to be about one-third that of the Finsen tube, and the shorter exposure leads to an economy in the cost of current consumed.

For the photographs which we have reproduced and that portion of the text descriptive of them, we are indebted to a young East Anglian friend who is now undergoing a second course of treatment. He had previously been a patient for six months, when he returned home for a brief period, and we can personally vouch for the extraordinary results produced by the arc light process.

PARLIAMENTARY COMMITTEES.

Yorkshire Electric Power Bill.

This Committee resumed its sitting on 4th inst.

Mr. Balfour Browne, at the commencement of the proceedings, said that before the evidence was resumed he thought it would be advisable for him to address the Committee. As representing Bradford he did not dispute the great benefits which would result to a wide district by giving powers to the promoting company to supply power. The points on which Bradford were opposing were very short. They did not in the least object to the promoters having way-leaves on the outskirts of the borough to reach places beyond, but they did very seriously object to the streets of Bradford, in the very centre of the town, being continually cut up to enable the company to get through to other places. As he understood, the promoters had drawn a circle within a radius of half a mile round the centre of Huddersfield in which no mains could be laid. Bradford being a larger place desired to have a circle drawn within a radius of a mile and a half. Whether that was reasonable or not he would discuss it with his learned friends and give evidence upon it. Outside the circle there would be no hardship in breaking up the roads. Bradford had no desire to act the part of the dog in the manger, and say that the company should not get through Bradford to places beyond. Then the company were seeking to supply railways and canals in the city of Bradford, and this he contended was not right. Bradford had been exempted from all competition with reference to the manufacturers. This was not the same case as the Cleveland, where, because the production was so small they thought it fair to come in and compete. At Bradford there was at present an installation of 6,800 h.p., and they were adding another 4,000 h.p. This year Bradford was in a position to supply the manufacturers, and the promoters had very properly exempted Bradford from competition in that respect; but they wanted to compete with Bradford for the supply of the railways and canals in the borough. He did not think it was reasonable to say: "You never shall compete for railways and canals," but he did ask the Committee to put the competition on the same basis as they had already done in every borough in the Cleveland district, and say that the Corporation should be able in the first instance to withold their consent. If the Board of Trade said the Corporation were withholding their consent unreasonably, then the Power Company should be able to come in and supply. If the promoters would insert a clause to that effect, as had had been done in the Cleveland case, he would be satisfied. If the Corporation could not sell current as cheaply as the company they ought to stand aside.

Mr. G. Fitzgerald, on behalf of Sheffield, agreed to everything Mr. Balfour Browne had said on behalf of Bradford. His clients would therefore be prepared to accept some such clause as Mr. Balfour Browne sketched out, putting them on the same footing as manufacturers in the Cleveland Bill, namely, that on default proved on the Corporation's part to the satisfaction of the Board of Trade, the company might come in and supply. With regard to wayleaves Sheffield stood in a very peculiar position. The promoters did not want wayleaves to pass through Sheffield to get from one part of their district to another. Assuming the other matter to be adjusted, although the company might get into Derbyshire by way of Handsworth, and if they showed sufficient reason for going through a portion of the outlying parts of the eastern side of the borough, he thought there would be no difficulty in coming to an agreement.

Mr. Brydges said that as representing the promoters he recognised that the speeches they had just heard put a very different complexion on the matter, and it would be necessary for them to consider the suggestion which had been made.

After some discussion the Committee decided to continue the evidence so far as it related to railways and canals.

Mr. Thomas Marston, manager of the Aire and Calder Navigation Company, and Mr. Williams, the general manager of the Leeds and Liverpool Canal Company, gave evidence in favour of the Bill, and said they were of opinion that the power which was proposed to be supplied by the promoters was admirably adapted for the purpose of canals.

Other local evidence having been given in favour of the Bill,

Mr. Baggallay said he thought he might be able to shorten the proceedings. He had carefully considered the suggestion of Mr. Balfour Browne, and on that he wished to say that the company hoped to get contracts from the railways and canals which would be very valuable in the starting of that undertaking. Such contracts would be of very great assistance, chiefly in raising capital. They could not make a contract with a railway or canal unless able to guarantee that they would be able to get a current of a certain tension and at a certain price throughout. The company wished, therefore, to be able themselves to make a contract with a railway or canal company and to guarantee a through supply; then, too, they should be under obligation to take a supply for the railway and canal from the Corporation if they were ready to give it at the same price as the company were able to give it. Some such provision as that should be included in the Bill.

After an adjournment for about an hour and a half, during which the Committee discussed the matter in private, Mr. Pember, K.C., for the promoters, said as far as he understood it was practically conceded that the company should get through the areas of the Corporations somehow, and the only question was as to how. With regard to the supplies to the railways and canals, the Committee knew from Mr. Baggallay the point to which the promoters were prepared to go. That did not seem satisfactory to the petitioners. If the Committee considered that the matter was now ripe for decision they might not want to hear any more evidence.

Mr. Wedderburn said he was glad to state that the Corporations of Leeds, Bradford, and Sheffield were now all of one mind, and were all prepared to submit to that which the Committee gave in the Cleveland case, and the suggestion which Mr. Balfour Browne made earlier that day. He proposed on behalf of the three Corporations the following clause: "Notwithstanding anything in this Act, the company shall not supply energy for use within the City of Bradford, Leeds, or Sheffield, to any railway or water company, or proprietors or trustees of any canal or navigation under this Act, unless and until in the case of any such city the corporation of such city shall have refused or neglected to give the required supply upon reasonable terms within a reasonable time after being requested in writing to do so by any such company, proprietors, or trustees." So long as the corporations were able to do, they were to be the first persons to undertake the work. If any dispute arose as to whether they were in a position to give the supply, &c., that should be determined by the Board of Trade. The proposal put forward by Mr. Baggallay was altogether unreasonable. The corporations desired that there should be competition, but the Board of Trade, upon proved facts, should be the judges of the competition.

The Chairman: You reject the promoters' clause?

Mr. Wedderburn: They have not proposed a clause. I object to their statement.

Mr. Pember: Inasmuch as my friend objects to the arrangement, the case must go on. Meantime, I ask for the clause in my Bill as it stands.

The Chairman: You withdraw Mr. Baggallay's statement?

Mr. Pember: I must.

The Chairman said the Committee considered that the preamble of the Bill was proved, and therefore they had better go on with the clauses.

Counsel having addressed the Committee for the opposing Corporation,

Mr. Pember, in replying, said the supply of electricity by the promoters of railways and canals was an essential part of the scheme, and he asked that they should be given power to supply to those two classes of undertakings even in the area of the Corporation.

The Chairman said that without giving a definite decision, he might say that it was the wish of the Committee that all the boroughs should be treated in the same way, and therefore they would like to hear why Huddersfield had been treated rather more kindly than the other boroughs.

Mr. Pember said he would deal with that matter on the following day.

The Committee then adjourned.

The Select Committee concluded its hearing of the Bill on 5th inst.

It was explained by Mr. Pember, on behalf of the promoters, in answer to questions which arose, that the Huddersfield Corporation and the surrounding districts had had better terms offered them because of their friendly attitude at the commencement of negotiations.

chemical inflammation of the skin.

waves of radiant energy in skin diseases, two forms of

Counsel on behalf of Bradford and Leeds asked for the insertion of the following clause in the Bill in substitution for the existing clause 47: "Notwithstanding anything in this Act the company shall not supply energy for use within the City of Bradford or the City of Leeds or the City of Sheffield to any railway or water company, or proprietors or trustees of any canal or navigation under this Act, unless and until, in case of any such city, or corporation of such city, shall have refused or neglected to give the required supply upon reasonable terms within a reasonable time after being required in writing so to do by any such company, proprietors, or trustees, provided that any dispute as to what constitutes refusal or neglect to give the required supply upon reasonable terms and within a reasonable time, shall be referred to and determined by the Board of Trade."

After discussion the Committee sat in private to consider the matter and on the parties being readmitted decided that Clause 47 should remain in the Bill as follows: "The powers of the company for the supply of energy under this Act shall be subject to the following restrictions, that is to say (1) Energy shall be supplied by the company only (*a*) to authorised undertakers, and (*b*) to persons requiring a supply of power. (2) The company shall not supply energy for lighting purposes except to authorised undertakers, provided that the energy supplied to any person for power may be used by such person for lighting any premises on any part of which the power is utilised. (3) The company shall not supply energy (except to authorised undertakers or to any railway or water company, or proprietors or trustees to any canal or navigation for power, in any area which at the date of passing of this Act, form's part of the area of supply of any authorised distributor without the consent of those distributors. Provided that where any distributing company refuse or withhold such consent, the company may appeal to the Board of Trade as to whether the consent of such distributing company is unreasonably refused or withheld, and the Board of Trade may dispense with such consent if in their opinion it is unreasonablly refused or withheld. The consent shall be deemed to be unreasonably refused or withheld, if such distributing company are not willing and in a position to give a requisite supply on reasonable terms, and within a reasonable time, and in considering what are reasonable terms, and what is a reasonable time, the Board of Trade shall amongst other things have regard to the terms upon which, and the time within which the company are willing and able to give the supply. (4) After any place shall become the whole or part of the area of supply of a distributing authority, the company shall not without the consent of such authority supply energy in any such place to any person (not being an authorised undertaker or a railway or water company, or the proprietors or trustees of a canal or navigation), who was not supplied by them previously to such place so becoming the whole or part of the area of supply of such distributing authority.

The matter of wayleaves was arranged between the parties, and the rest of the clauses having been gone through, the Bill was ordered to be reported to the House for third reading.

Tyneside Tramways.

Last week a Select Committee of the House of Commons, presided over by Mr. W. H. Holland, commenced the consideration of the Tyneside Tramways and Tramroads Company's Bill which has already passed through the House of Lords. Power is sought under the Bill to construct a tramway from the Eastern boundary, Newcastle-on-Tyne, through Walker and Wallsend, to North Shields, and a tramroad from Wallsend to Gosforth. The opponents to the Bill were the Newcastle-on-Tyne Corporation, the Walker Urban District Council, the North-Eastern Railway, and the National Telephone Company. The National Telephone Company were not represented by counsel.

Mr. B. Browne, in opening the case for the promoters, referred to the opposition of Newcastle, and said that his clients had pledged themselves to meet every proposal of the Corporation, including the making of tramways in the Walker district. Another objection on the part of the Newcastle Corporation, was that in some places the lines came within 9 ft. 6 ins. of the kerb; but in Newcastle there were 9 miles of tramways within that space of the kerb. The Corporation further took exception to a clause in the Bill referring to the agreements as to the electrical power, but it was made as clear as noonday in the other House that the promoters were not going to take any energy from the works in Newcastle, but from the works that were being erected at Wallsend.

Evidence was then called in support of the scheme and the Committee adjourned.

On resuming on Monday evidence was given on behalf of the Walker Urban District Council, who in reply to Mr. Pembroke Stephens, K.C., said the question of tramways was of the greatest importance to Walker, and they had come to the conclusion that their best interests would not be served if a private company were allowed to come into the district. His Council were anxious to come to terms with the Newcastle Corporation rather than with the promoters of the Bill, believing that it would be better for the district. He was aware that the company had made most liberal promises, but the feelings of the Council was that the real interests of the borough lay in the extension of the Newcastle tramways.

Further evidence to the same effect was tendered by various local witnesses, and the Committee again adjourned.

After hearing further evidence, the Committee announced that they had decided to pass the preamble of the Bill.

Dealing with the clauses, Mr. Balfour Browne, K.C., on behalf of the promoters, asked that a clause should be inserted in the Bill giving the company powers over a piece of line in Walker and Wallsend which connected these places.

Mr. Pembroke Stephens, representing Walker, asked the committee not to accept the clause.

The Chairman said that as Walker had been so successful on the previous day he thought they should meet the company in a generous spirit, and give them all reasonable facilities to work the tramways successfully. The idea of the promoters was to bring about a through service which would be for the advantage of the public. He wished to say that the Committee considered that the Tyneside Company had rendered a public service in bringing forward the Wallsend portion of the Bill, inasmuch as it had caused the other authorities to take immediate steps towards providing tramways.

Mr. Moon said the North-Eastern Railway, for which he appeared, objected to that clause which would allow the tramway company to carry parcels weighing over 56 lbs. The company proposed to carry goods and minerals not only for their own use but also for the use of the two generating stations supplying electricity for the working of the tramways. His clients objected to that because the current was to come from the Newcastle Electric Supply Company's works, which would not only be supplying the Tramway Company, but also a great part of Newcastle. They would not object to the company having power to carry sufficient coal to produce the power necessary for the supply of the tramways.

After deliberating for some time the Chairman said the Committee had decided that, as there would be a great difficulty in ear-marking the precise quantity of coal used for tramway purposes at the generating stations, they would allow the whole of the coal used there to be carried.

Mr. Forbes Lancaster, on behalf of the National Telephone Company, asked for the insertion of a clause similar to that which the Committee had inserted in the South Lancashire Tramways Bill, providing that his company should not be liable for any damage caused by the escape of electricity from the trolley wire of the tramway through any of the telephone wires unless it was proved that such escape was due to their wilful default, in which case the companies should be jointly liable.

Mr. Balfour Browne asked the Committee not to accede to the application of the National Telephone Company, and said that what had been done in the case of the South Lancashire Bill was a very serious departure from general principles and from the ordinary law. He understood that the Chairman of Committees in the House of Lords had objected to the clause, and that in the opinion of counsel to Earl Morley, any damage or injury proved to be caused by the escape of electric current from the tramway wires would seem to be a damage for which the company would *prima facie* be liable at law, and the same would hold good if the fault were that of the National Telephone Company. In his opinion the clause altered the law in favour of a non-statutory company. It was a most important point for all companies having electrical wires for the working of tramways in this country.

Mr. J. Fitzgerald, K.C., on behalf of the Birmingham Tramways Company, supported Mr. Balfour Browne's appeal to the Committee not to insert the clause, but the chairman said the Committee were of opinion that the clause should be inserted, as they had heard nothing which would induce them to change their mind.

The remaining clauses were then adjusted and the Bill was ordered to be reported to the House.

Manchester Corporation Bill.

On 2nd inst. a Select Committee of the House of Commons, presided over by Mr. A. De Tatton Egerton, had before them a Bill of the Manchester Corporation with reference to the construction of tramways.

After hearing evidence, the Committee decided that the preamble of the Bill had been proved, and the clauses having been gone through, the measure was ordered to be reported for third reading.

Cleveland and Durham Electric Power Bill.

The consideration of this Bill was continued last week when Mr. Gibbs, the general manager of the North-Eastern Railway Company, gave evidence in its favour. He said that electricity as applied to railways and docks was becoming a real public necessity for the efficient conduct of business, and people were directing their attention to it more and more. In order that they might have the advantage possessed by foreign countries, he thought it desirable that provision of the kind contained in the Bill should be made.

In reply to the Chairman (Lord Brougham), Witness said he had no doubt that if the Bill was passed his company would become customers, although they had not yet considered any practical application of the facilities that would be available. He considered it would be greatly to the advantage of his company to be able to deal with one company rather than with a large number of local authorities.

Replying to Mr. Acworth, representing the Middlesborough Town Council, the Witness said he thought the advantage of the present scheme would be that the company would be able to supply electricity at a long distance from their generating station. He knew that Middlesborough supplied electricity, and he had never heard any complaints made against the manner in which the Corporation had carried on their undertaking.

Other local evidence having been given in favour of the Bill,

Mr. Robert Hammond, spoke in opposition to the scheme on behalf of the Corporations of Stockton and Middlesborough, and stated that in his opinion it did not fulfil the conditions laid down by Lord Cross's

Committee, which reported that in cases where sufficient public advantage could be shown, power might be given to public companies to supply electrical energy over large areas, including the districts of several local authorities demanding plant of exceptional dimensions and high voltage. The public advantages to be given by this scheme were certainly not such that they should be allowed to outweigh the prior claim of the Corporations to supply electricity within their own districts.

Alderman Hine, Mayor of Stockton, stated that the Corporation desired to have power to come to an agreement with the company, but they certainly objected to the promoters having compulsory power to come in and force themselves on the town. The Stockton Corporation were willing to supply anyone who applied for electricity.

Alderman Barron, Chairman of the Gas and Electric Lighting Committee of Darlington Corporation, said Darlington had its own electrical works, and was prepared to supply electricity both for lighting and power.

Dr. Williams, on behalf of the Corporation of West Hartlepool, said if the Committee passed the Bill in its present form it would be the first time in Parliamentary history that a Committee had interfered with vested rights, those vested rights being the rights of the Corporations to supply in their areas.

The Committee adjourned.

Prof. Kennedy gave evidence on behalf of Darlington in opposition to the Bill, and said that although the Corporation works were only opened last December, the demand for energy was so great that it had been decided to double the installation. That would make the works equal to 800 or 900 H.P. The Corporation proposed to work the tramways in the borough by electricity. Last year a company proposed to run trams, and the Corporation offered them a supply of electricity for the purpose, up to 400,000 units per annum, at 1½d. per unit, and any quantity above was to be charged at 1d. per unit. The Corporation also made an offer to supply Messrs. Stevenson at 1½d. per unit, plus an extra charge of about $\frac{1}{10}$d. per unit, up to 500,000 units, and above that rate the extra charge would not come into operation. The company had stated before the House of Commons that they would be able to supply at 2d. up to 500,000 units; 1¾d. from 500,000 to 750,000; which charge would be reduced to 1½d. on quantities between 750,000 to 1,000,000. In his opinion there were many economies which could be carried out at small stations which could not be effected at large ones. He did not think it would be an economical system to give Darlington a supply from a station 19 miles away, as was suggested.

Dr. Williams, for the West Hartlepool Corporation, asked the Committee not to grant the promoters the powers they sought, on the ground that the Corporation had their own electrical works in operation. Their system of supply was the continuous three-wire, which was suitable for the supply of either light or power. They had offered to supply at 1½d. and 1d. per unit, and he felt sure that a private company would not be able to supply cheaper than that.

Evidence having been tendered by Alderman Barron, the Chairman of the Electric Lighting Committee of Darlington, Mr. Fitzgerald, K.C., addressed the Committee for the Corporation in opposition to the Bill, and argued that there was no reason why the promoters should be allowed to touch Darlington, as the works they desired to supply were outside the borough. If all the petitioning boroughs were excluded from the scheme, the promoters would still have a district covering 800 square miles. If the Committee passed the Bill, he hoped they would insert a clause by which the company would be prevented from supplying Darlington except with the permission of the Corporation.

Mr. H. C. Crummock, the borough engineer of Hartlepool, examined by Mr. Hans Hamilton, said that the Corporation obtained their provisional order about a year and a half ago, since which time they had prepared a complete scheme for the supply of electricity both for power and lighting purposes. There were various large works in the borough, and he anticipated that the demand the Corporation would have to meet at first would not be more than 200 KW. Of course, if it increased it would be easy to lay down additional plant. They had power to purchase the local tramways, and if they decided on such a course they would convert them into electrical lines, which would enable them to increase the load factor at their works.

Mr. Hans Hamilton, in addressing the Committee on behalf of Hartlepool, argued that it would be most unfair to allow the promoters to come into the borough seeing that the Corporation had power to supply all the light and power that was required,

The Chairman said they would not call upon Mr. Balfour Browne to address them as, in the opinion of the Committee, the preamble of the Bill was proved. They, however, intended to strike out the provisos which related to Heston and Messrs. Bolckow, Vaughan and Co.

Subsequently the Committee went through the clauses with the Parliamentary agents, and the Bill as amended was reported to the House of Lords for third reading.

Handsworth U.D.C. Bill.

The Bill of the Handsworth Urban District Council having been through the Lords, came before the Committee of the House of Commons on Unopposed Bills on 4th inst, and was ordered to proceed. The Bill confers powers on the Council with respect to tramways and electric light.

Birmingham Tramways.

Mr. W. H. Holland's Select Committee of the House of Commons considered the Bill of the City of Birmingham Tramways Company on 3rd and 4th inst. The objects sought by the Bill were fully set forth in the Electrical Review when the Bill was before the Lords' Committee, by whom it was passed. Various new lines are intended to be constructed in order to facilitate the working of the whole system.

The promoters were represented by Mr. J. D. Fitzgerald, K.C., and the opponents to the Bill were the Aston Manor Urban District Council, the King's Norton Urban District Council, and the Handsworth Urban District Council.

Mr. Fitzgerald explained the curious condition of affairs with regard to the tramway system of Birmingham, where different lines were worked by horse, cable, steam and electricity. The tramways inside the city were owned by the Corporation and leased to the company, but beyond the city the company itself owned the tramways, which were, however, subject to the usual purchase clause by the local authorities. The powers of the local authorities to purchase became operative at different dates, commencing with 1903, and unless some arrangement was made for the working of the lines serious public inconvenience would result. What the company wanted was running powers over the portions of the route which passed into the hands of the local authorities until the lease to the company of the tramways within the city had expired.

Mr. H. Young, on behalf of the Aston and Handsworth District Councils, said the petitioners had arranged certain clauses with the promoters by which they were enabled to withdraw their opposition to the preamble of the Bill. The basis of the agreement was that Aston and Handsworth agreed that when the time arrived for their sections of the tramways to accrue to the respective councils they would grant to the company leases for periods to expire on the same dates as the leases of the Birmingham Corporation expired.

The Committee, on this understanding, declared the preamble of the Bill proved, and it was ordered to be reported for third reading.

Tramway Provisional Orders.—Pontypridd Tramways.

The Tramways Orders Confirmation (No. 1) Bill came before a Select Committee of the House of Lords, presided over by Lord Clonbrook, last week. The Bill confirms the orders of the Board of Trade for the construction of tramways to the Ashton-under-Lyne Corporation, Denton Urban District Council, Devonport Corporation, Liverpool Corporation, Northampton Corporation, and Pontypridd Urban District Council.

The only order opposed was that of the Pontypridd Urban District Council, and the opponents were the Taff Vale Railway Company.

Mr. Ram, K.C., opened the case for the promoters, and stated that last year an application made by the British Electric Traction Company for permission to construct a tramway over the route proposed in the present Bill was refused on account of the opposition of the Taff Vale Railway Company. The people in the locality now looked to the Urban District Council to make the necessary tramway provision, and although the British Electric Traction Company were still attempting to obtain authority to construct the tramways, they would be opposed by the Urban District Council, and also by the Glamorganshire County Council. With regard to the opposition of the railway company, he contended that they could not accommodate the traffic, and submitted that the *locus standi* of the railway company should be confined to competition.

Mr. Fitzgerald, K.C., who appeared for the railway company, pointed out that his clients were paying ¼th of the rates of the town, and under that Bill, they would be called upon to pay rates for a scheme which would be in opposition to themselves.

The Committee consulted together, and decided that the railway company should have a right to be heard as ratepayers.

Mr. Balfour Browne, suggested that there had been collusion between the promoters and the British Electric Traction Company, but this the counsel for the promoters repudiated.

After hearing evidence on both sides, the Committee declared the preamble of the Bill proved, and it was ordered to be reported for third reading.

Blackpool Corporation Bill.

The Omnibus Bill of the Blackpool Corporation, which has already passed through the House of Commons, was before a Committee on 4th inst, presided over by Lord Hatherton. Amongst the proposals in the Bill was one for the extension of the tramway from Waterloo Drive, along Middle Lane, to the Borough boundary to Symons Gate Lane, and this was opposed by the Blackpool, St. Anne's and Lytham Tramways Company, on the ground that the tramway running parallel to Lytham Road was intended to compete with the line leased to the Corporation by that company.

The promoters were represented by Mr. Freeman, K.C., and Mr. Ram, K.C.

After hearing evidence the Committee found that as regarded the tramway No. 11, which was opposed by the Lytham Tramway Company, the preamble of the Bill had not been proved. The other part of the tramway scheme was agreed to.

Chester Corporation Tramways.

On 4th inst. the Bill of the Chester Corporation, giving that body power to reconstruct existing tramways and construct additional tramways, was before the Unopposed Bill Committee of the House of Commons, having already passed the Lords. The Bill was ordered to be reported.

Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board.

This Bill which, as stated in last week's Electrical Review was found by the Examiner of the House of Lords not to have complied with Standing Orders, came before the Standing Orders Committee on 4th inst., and it was agreed to suspend Standing Orders and allow the Bill to proceed. It has passed the House of Commons.

Worcester Tramways.

On Monday the Court of Referees of the House of Commons heard the objection of the Worcester Tramways Company to the National Telephone Company having a *locus* against their Bill now before Parliament. The Tramways Company Bill provides for the reconstruction of existing tramways and the construction of additional tramways in the city of Worcester, and the working of the same by mechanical traction. Mr. Forbes Lancaster appeared for the Telephone Company, and argued that they should have been allowed a *locus standi* before the Committee so that they might endeavour to obtain the insertion of a clause in the Bill similar to that which was inserted in the Bill of the South Lancashire Tramways Company. This clause (which was given in full in the Electrical Review of July 5th in the case of the South Lancashire Tramways Bill) deals with the liability of the National Telephone Company and the Tramway Company in the event of their overhead wires coming into contact.

The Court refused to grant a *locus* to the National Telephone Company, and the Bill will consequently go before the Unopposed Committee.

Bournemouth Corporation Bill.

After occupying the consideration of a Select Committee of the House of Lords several days the preamble of the Bournemouth Corporation Bill was declared proved on Monday. Last session the Corporation were authorised to construct tramways within the borough, and this session under the Bill power was sought to construct additional tramways within and beyond the borough, to make street widenings, and for other purposes. The lines sought to be constructed were:—No. 1, 2 furlongs $\frac{1}{8}$ chains; No. 2, 2 furlongs 2 chains; No. 3, 1 mile 4 furlongs 2 chains; and No. 4, 5 furlongs $\frac{7}{8}$ chains and two small bits. No. 3 tramway is wholly within the Urban District of Winton. Power is also given that where any local authority for any district adjacent to the borough or along the route of any tramway owned or worked by the Corporation desires to be supplied with electric energy by the Corporation, the Corporation may, with the approval of the Board of Trade, supply such electric energy, and may raise money for such purposes under the provisions of the Electric Light Acts of 1882 and 1888, in like manner as if such district were part of the area supplied under the Bournemouth Electric Light Order, 1899. Borrowing powers for tramway construction are given to the extent of £14,000, and lands in Southcote Road are scheduled for an electric generating station. The opposition to the Bill was in respect to certain street widenings required to carry out the tramway scheme.

Hendon and Finchley Tramways.

The Examiners of Standing Order Proofs in the House of Commons on Monday considered the Hendon and Finchley Tramways Bill, which has been through the House of Lords, and ordered further Standing Orders to be complied with.

London United Tramways.

The Bill of the London United Tramways Company which has already passed the House of Commons, came up for proof of compliance with Standing Orders before the Examiners of the House of Lords on Monday, and further Standing Orders were ordered to be complied with.

City and Brixton Railway.

This Bill, for conferring further powers on the City and Brixton Railway Company in respect to an extension of time for the purchase of land, &c., came before Lord Welby's Committee of the House of Lords on Monday. The petitioners, the London County Council and the City Corporation, made no appearance, and the Bill was referred to Lord Morley's Committee on Unopposed Bills.

Electric Lighting Provisional Orders.

Electric Light Provisional Orders (Nos. 6 and 10) Bills, which have passed the House of Lords on 5th inst., came before the House of Commons Committee on Unopposed Bills, and were ordered to go forward. No. 6 confirms the Provisional Orders granted by the Board of Trade to the Corporation of Aberavon, the Rural District Council of Neath, and the Urban District Councils of Ashton-in-Makerfield, Hampton, Ince-in-Makerfield, Mountain Ash, Pontypridd, Teddington, and Worsley. No. 10 confirmed Orders to Blackrock, Dungannon, Kildare, and Waterford.

Electric Light Provisional Order Bills Nos. 7, 8, 9 and 11, which have passed the Upper House, were on Monday before the Examiners of the House of Commons, and further Standing Orders were ordered to be complied with. Full particulars of areas and undertakers, included in No. 7 Bill, appeared in the Electrical Review of June 28th, and similar particulars of Bills 8, 9 and 11 in the June 21st issue. They deal with Electric Orders to the following districts:—Barry, Crompton, Foot's Cray, Friern Barnet, Isle of Thanet, Newbury, Pudsey, Ross, Royton, Roundhay, Clydebank, Crieff, Dalkeith, Dollar, Falkirk, Galashiels, Gourock, Jedburgh, Melrose, Oban, Alnwick, Annfield Plain, Benfieldside, Consett, Handsworth, Norton, Pickering, Shildon, St. Austell, Whitley and Monkseaton, Bromsgrove, Goole, Ilkley, Lyndhurst, Midland Electric Power Distribution and Lighting Extension, Northwood and Ruislip, Rickmansworth, Rishton, Great Harwood and Clay-le-Moors, and Warwick.

Lowestoft Corporation Bill.

The Omnibus Bill of the Lowestoft Corporation came before the Standing Orders Committee of the House of Commons as an unopposed measure on 5th inst. The Bill authorises the Corporation to construct a number of tramways in the borough and confirms an agreement made between the Corporation and the National Electric Traction Company, Limited, and the Drake & Gorham Electric Power and Traction Pioneer Syndicate, Limited, whereby the Corporation grants a lease to the Drake & Gorham Company of the line to be constructed for a term of 28 years, subject to power being reserved to the Corporation to give notice at the end of 7, 14 or 21 years of intention to terminate the lease. There are also clauses in the Bill dealing with the electric light undertaking and giving power to supply electric energy outside the borough, and for traction purposes.

Manchester and Liverpool Electric Express Railway.

The Manchester and Liverpool Express Railway Bill which has already passed through the House of Lords, came before a Committee of the House of Commons, presided over by Sir C. MacIver, on 4th inst.

Mr. Balfour Browne represented the promoters, and explained that last year, when the Bill came before the House of Commons, they tried to prove that a high-speed electric railway was required between Manchester and Liverpool, and that the scheme was supported by a large number of the leading members of the commercial world in the district. Principally for the reason that the House of Commons Committee considered that the interests of the Mersey Docks and Harbour Board and the Salford Corporation was not sufficiently protected, the preamble of the Bill was not found proved, but he was very glad to say that that day he had practically no opposition but the railway companies to the Bill. The Mersey and Harbour Board were satisfied with the arrangements made, and he believed that terms had also been arranged with the Salford Corporation. Consequently the whole question came down to whether there should be competition allowed with the existing railways, and he contended that the Committee, in the public interest, should say whether such competition should be allowed. It was contemplated that the proposed express should run from 110 to 120 miles an hour. This was secured by the use of the mono-rail, by the generation of the power at a central station at Warrington, and its transmission to comparatively light motors on the cars themselves. Therefore the cars had not nearly so much to carry as the ordinary railway. Electricity, too, had rotary and not reciprocating action, and that was a very great advantage in favour of electric traction. The only point which gave the Lords' Committee concern was the question of the centre of gravity of the cars. The promoters pledged themselves that the centre of gravity should be at least 12 in. below the top rail, and that undertaking had now been embodied in the Bill. Manchester and Liverpool were selected for this experiment, not merely for historical reasons, but in order to make it a successful commercial experiment. The promoters must have two great centres of population, one at each end. But he did not suggest that the mono-rail was going to stop there. Probably next year there would be a proposal for a mono-rail between London and Brighton, and he believed that for communication between large towns the mono-rail would be the means by which the fast traffic would be carried in the future.

Mr. Fritz Bernard Behr, the designer of the present scheme and joint engineer of the line, was then called and examined by Mr. Blennerhassett. He stated that the idea of the mono-rail was at least a century old; but he had for the first time designed and invented those details which alone rendered it practicable and applicable to ordinary railway travelling. He explained in great detail the circumstances which preceded the Parliamentary promotion of the scheme, the construction of the permanent way and passenger cars, the signalling apparatus and brake power. Much of his evidence was illustrated by demonstrations given on the model of the proposed line, which ran from side to side of the committee room.

The Committee then adjourned.

At the resumed sitting of the Select Committee on 5th inst., further evidence was given by Mr. Behr as to the traffic between Liverpool and Manchester which he anticipated the new railway would get. He pointed out that now the passenger traffic per day between the two towns was about 8,500 per day. He had designed two sets of carriages, one which would carry 10,000 passengers, and another 7,500 a day. There would be 204 trains a day, and if each carried eight third-class passengers at the existing fares the working expenses would be covered, while if 20 passengers were carried it would enable 5 per cent. to be paid on the capital. He based this estimate on the figure of 8d. per car mile for working expenses. The total capital would be £2,800,000.

In cross-examination by Mr. Littler, K.C. (who represented the Cheshire Lines Committee), Witness said he had submitted a system

mono-rails to the French School of Military Engineering, but he was not aware that that line was partially constructed, and was so unsatisfactory that it was abandoned. The experimental train in Brussels on which the King of the Belgians was riding did not break down, but it was true that the car stopped owing to the failure of the electric current. If it was necessary provision could be made to carry 60,000 passengers a day. The cars would be 18 in. apart when crossing, and would be only 18 in. from the ground.

Witness was further examined at considerable length as to who was bearing the cost of the Parliamentary application, and said that most was borne by the Manchester and Liverpool Committee.

The Committee adjourned.

On Monday M. Gerard, Chief of the Belgian State Railways, gave evidence in support of the Bill. He was president of a Government Commission appointed to examine the Behr high-speed railway at the Brussels Exhibition. At that exhibition the absence of springs in the guiding wheels had the effect of not allowing the experiment to be worked with mathematical perfection, and the embankments were soft, and therefore not calculated to assist the good working of the railway. If the Government decided to construct a high-speed railway between Antwerp and Brussels, he should recommend the monorail system. At Brussels it was demonstrated that 75 miles an hour could be obtained with perfect safety on a curve, and he said with confidence that it was easy to design a line sufficiently strong and stable on which a greater speed than that at Brussels could be secured. In his opinion with adequate electrical power, a speed of 100 or 110 miles an hour could be easily and safely obtained.

In cross-examination by counsel for the Cheshire Lines Committee, Witness expressed the opinion that the cars, which were used at Brussels were sufficient to test the railway, although some of the weight was taken off them owing to the inefficiency of the electrical power. He knew of no other applicable system than the monorail which would allow a speed of 100 to 110 miles an hour.

The Chairman: What is the position of your Government in regard to these electric railways?—They are favourable to such projects, but whether they will employ public money in their construction or leave them to private enterprise, they have not yet decided.

M. De Graux, engineer-in-chief and managing director of the traction and minerals department of the State railways of Belgium, also gave similar evidence to the previous witness, and said that in the experiment made at Brussels the generating appliances for getting the electricity were constructed in great haste, with the result that the installation was not so good as desired. He believed that there was absolute safety in the system.

The Committee adjourned till Wednesday.

London Underground Railways.

The Joint Committee of both Houses of Parliament sitting to enquire into the question of routes proposed for the various underground electric railways to be promoted in London, resumed on 2nd inst. for the purpose of hearing counsel on behalf of owners and occupiers who might be affected by damage caused by the construction and working of the railways.

Mr. Pember, K.C., who represented the Gordon Hotels Company, asked that the Committee should make a declaration in favour of granting a *locus standi* to owners on the lines of route, even although the railways did not go under their property. He argued that it was quite possible that without actually going underneath the property, injury might be caused by the vibration, and such owners ought to have a *locus standi* before the committee which considered the Bill.

Mr. Pollock, K.C., for a number of private landowners, Mr. Fitzgerald, K.C., for L.C.C., and Mr. Freeman, K.C., and other counsel having addresed the Committee in similar terms, the Committee, after hearing for some time in private, adjourned.

Blackburn Corporation Bill.

The Omnibus Bill of the Blackburn Corporation, which has passed the Commons, was before Lord Morley's Committee on Unopposed Bills on Tuesday, and was ordered to be reported for third reading in the Lords. The Bill gives power to reconstruct about five miles of existing tramways, and construct between three and four miles of new tramways. Power is also taken to obtain running powers over the Blackburn, Whalley, and Padiham Light Railways Company's lines and to grant that company running powers over the Blackburn lines, and also to purchase the company's lines at Rishton should it become insolvent. The estimated cost of the tramway works under the Bill is £152,000.

Derbyshire and Nottingham Electric Power Bill.

On Tuesday this Bill, which was reported upon fully in the Electrical Review when considered by the Select Committee of the House of Commons, came before Lord Morley's Committee of the House of Lords on opposed Bills, and was ordered to be reported for third reading. The scheme embraces practically the whole of Notts and Derbyshire, and the proposed capital is £1,800,000, with £600,000 borrowing powers.

Electric Lighting at Lewisham and Penge.

Electric Light Provisional Order (No. 12) Bill, which deals with the electric lighting of Lewisham and Penge, was before the Examiner of Standing Orders in the House of Commons on Tuesday, and the Standing Orders were found to have been complied with. The Bill has already been before the House of Lords. The undertakers are the Lewisham and District Electric Supply Company.

Kingston-upon-Hill Corporation Bill.

On Tuesday the Omnibus Bill of the Kingston-upon-Hull Corporation came before Earl Morley's Committee of the House of Lords as an unopposed measure, and was ordered to be reported for third reading. The Bill authorises the Corporation, amongst other things, to lay down tramways to be worked electrically.

LEGAL.

Wrigley *v.* the Windermere District Electricity Supply Company.

This case was again mentioned to Mr. Justice Kekewich in the Chancery Division on Friday last. It was an action brought by the plaintiff for an injunction to restrain the defendants from committing a nuisance by noise, smoke and vibration. After some discussion between the counsel engaged, it was arranged that the parties should arrange for the inspection of the defendants' premises by some suitable person, so that he could report to the Court whether he considered there was a nuisance caused by noise, smoke and vibration, and whether, in his opinion, anything could be done by the defendants to remedy it.

His Lordship fixed the hearing of the action for July 30th.

British Electric Works Company, Limited.

The petition of Samuel Walker, Limited, for the compulsory winding-up of the British Electric Works Company, Limited, was down for hearing in the Companies Winding-up Court on Tuesday.

Counsel for the petitioners said the company was now in voluntary liquidation, and it had been arranged that the petition should be withdrawn, the liquidator paying the costs.

Mr. Eve, K.C., who appeared for the company, said they had sold their assets, and there was sufficient to pay all the creditors in full and make a return to the shareholders.

His Lordship allowed the petition to be withdrawn.

CORRESPONDENCE.

On Polyphase Generating and Sub-station Plant for Electric Traction.

I should like to be permitted to reply to a few criticisms made by Mr. H. S. Meyer in your issue of July 5th on some questions dealt with by me in an article having the above title, which recently appeared in your journal.

Converter Efficiencies.—I am by no means prepared to accept Mr. Meyer's "corrections" to my figures. The figures I gave for the efficiency of 500-kw. rotary converters and synchronous motor-generators are representative of what is *actually obtained* in good modern practice with these machines when working under the conditions given. The figures for *each* type of converter are about 1 per cent. less than the best obtainable, and the comparison made by me is perfectly fair to both classes of plant. A high speed 500-kw. railway generator of standard design will never have a better full load efficiency than 94 per cent. (including bearing friction) except on paper, and a representative figure for various types is 93·6 per cent. The corresponding standard high pressure synchronous motor provided with solid pole-pieces (or laminated pole-pieces and damping coils) will have a full load efficiency ($\cos \phi = 0{\cdot}95$) not greater than 93·6 per cent., including excitation and bearing friction, and a representative figure is about 93·2 per cent. These figures are based upon the results obtained by test on quite a large number of Continental and American machines of different makes, and may be taken as being correct for commercial machinery of standard design. Again, 92 per cent. for the combined full load efficiency of rotary converter and step-down transformers is quite a representative American figure, and can be improved upon. In this way I get the following full load figures as a fair and representative comparison:—

	Motor-generator.	
Rotary converter.	(Actually obtained.)	(Meyer.)
93—92 per cent.	88—87 per cent.	89 per cent.

and similarly for other loads, the difference in the efficiency of the two types of converter being always about 5 per cent. at full load, and 8 per cent. at half load, in favour of the rotary converter.

E

included in No. 7 Bill, appeared in the ELECTRICAL REVIEW of

Cheshire Lines Committee), WITNESS said he had submitted a system

I consider Mr. Meyer's figure quite unattainable with *standard* machinery; incidentally, I may be permitted to point out that, even assuming the respective machine efficiencies put forward by Mr. Meyer to be correct for general cases, the figure of 89 per cent. is by no means attained, owing to his arithmetical error in combining these efficiencies.

Use of Damping Coils.—Whether these should be used or not with rotary converters is, of course, largely a matter of individual opinion when the phase displacement is as small as 2°. Considering the insignificant cost of these coils, and their great value should hunting be set up (by a short circuit, for instance), I always advocate their use in connection with the sub-station machinery with schemes of any magnitude, simply as a measure of precaution. Mr. Meyer is quite mistaken in thinking that the losses in them reach 1½ per cent.—it is by no means difficult to estimate these losses approximately from the temperature rise, and the results of tests show that the figure is as given by me, namely, 0·5—0·75 per cent. If the losses were really as large as Mr. Meyer thinks, this would be a clear indication that the damping coils are badly wanted and should always be used.

Of course, if the phase displacement exceeds that given above, or if the engine governors are unsuitable, I can readily believe that Mr. Meyer's losses would be attained, as might also be the case if the rotaries themselves were of unsuitable design, or unsuitably arranged.

High-Pressure Tests for Generator Armatures.—The figures I gave conform to the latest rules of the German Institution of Electrical Engineers, being the joint recommendations of all the most important Continental manufacturers and most experienced engineers. It was, of course, to be understood that the break-down test is to be made with hot windings—as almost universally carried out, the test is made after a long run at full load.

I consider that in this matter the Continent has nothing to learn from America, for it is comparatively recently that the generation of the high-pressure current directly in the generator armatures has been adopted in the States, while on the Continent no other method has even been considered (up to 20,000 volts) for years, even for quite small plants. Personally, considering the effect of these very high pressures upon dielectric strength, I consider it quite illogical to employ the same rule for 15,000 volts as for 5,000 volts. To use continuously a test pressure in the former case of double the normal only needlessly strains the insulation; 50 per cent. excess pressure, applied for 30 minutes, is an amply sufficient test for armatures of this voltage.

Converter Momentum.—I have found in several instances that the addition of a fly-wheel to a synchronous converter has made hunting worse. Although I am not prepared at the moment to assert positively that such machines should *always* be designed to have as small a momentum as possible, still, the experimental evidence available, points to this conclusion as being the right one, while *generally* I am convinced it is correct.

Extra Low Frequencies.—I do not consider that Mr. Meyer's claim that better synchronising is possible at extra low frequencies is any justification for the employment of such an abnormal frequency as eight cycles, for it is, I think, a theoretical rather than a practical advantage. There is no difficulty whatever in perfectly synchronising the largest generators of 40—50 cycles, provided proper arrangements are made and reasonable precautions taken, and, therefore, this point need not be considered at all.

Fly-wheel Effect.—I do not quite understand the bearing of Mr. Meyer's reasoning on this question, looking at it (as I did in my article) from the electrical engineer's point of view. All the latter stipulates is that the cyclic irregularity shall not exceed a certain amount, which he determines for each particular case, and gives to the engine builder. It is surely quite immaterial how the latter makes his calculations as long as he gets the desired result, and in consequence gives the guarantees demanded. I think most electricians would be very sorry to interfere in the engine builder's work by asking him to produce his calculations and data, for there can be no doubt as to what reply the engine builder would give.

The latter knows exactly what is wanted if he is told that the cyclic irregularity must not exceed a certain value, for the figure so given is perfectly definite; if it is exceeded—and this sometimes happens, in spite of the large safety factors most engine builders employ in such calculations—the electrician has his remedy. If trouble arises in a particular case, all that has to be done is to measure what the cyclic irregularity actually is by one or other of the well-known methods (such as with a Braun tube, or with a tuning fork, or a tachograph, or by the electrical method described by Mr. Meyer), and if found to be more than guaranteed, the engine builder must, of course, be held responsible. There can be no ambiguity on this question, and I really cannot see why engine builders should not be trusted to use their own methods in making what is, after all, a fairly straightforward calculation, based upon the results of their previous experience with the type of engine in question.

A. C. Eborall.

London, *July 8th*, 1901.

Three-wire Tramway Supply.

I beg to thank Mr. Stewart for his kind reply to my enquiry which appeared in your issue of June 14th, with reference to the three-wire system for tramway supply. I understand from his answer that working under normal conditions no objection to the system arises, but in the event of a short circuit, fuses would blow, and the service be temporarily suspended, which, I presume, is precisely what would happen in a similar case with a two-wire tramway system. The system would, of course, be entirely separate from any lighting system and would have 1,000 volts between the outers, the rails being effectually earthed throughout.

Silex.

The Maximum Demand System of Charging for Electricity.

In commenting upon Mr. Chamen's address before the Glasgow Convention of the Municipal Electrical Association upon the above subject, you say (in your issue of 28th ult.): "We should like Mr. Chamen and others who recommend . . . . specially low rates for churches and chapels . . . . to show the reconciliation between such preferential treatment and the main argument of this address." But surely, when one considers the circumstances of the case, it is self-evident that such special rates are perfectly logical. The maximum demand system is but an approximation to a perfect method of charging for electricity; and that it works so satisfactorily in the majority of towns where it has been introduced, is largely to be attributed to the fact that the great majority of consumers make their largest call for power at a time when the power station is working at its greatest capacity.

A hypothetical case, which is quite possible though very unlikely to occur in so exaggerated a form, will illustrate the defects of the maximum demand system :—

Consider a central station having total capacity (exclusive of standby plant) of 1,000 KW., the maximum demand being the same. Average load, 150 KW., so that the load factor is 15 per cent. Standing charges, for sake of argument, may be taken as £10 per kilowatt per annum, and actual costs of generation, 0·8d. per unit.

Suppose now, two large customers apply for connection, each requiring 100 KW. as a maximum demand, and consuming an average of 240 units in each 24 hours (Sundays included) so as to have a personal load factor of 10 per cent.

Consumer A requires his maximum supply at the time of the station "peak," and therefore additional plant to the extent of 100 KW. must be put down for his special benefit. A's bill for current for the year should therefore include—

1. Standing charges on 100 KW. at £10 per KW. ...	£1,000
2. 240 × 365 = 87,600 units consumed at sale price of 1d. per unit	365
	£1,365

(*i.e.*, an average price of 3¾d. per unit),

while the actual profit to the station would be 87,600 units at 0·2d. per unit = £73 towards relief of rates, &c.

Consumer B, on the other hand, requires his 100 KW. only at a time when the central station is lightly loaded, and is quite willing to be entirely cut off when the hour of the "peak" comes round. There is thus no necessity whatever for any additional plant to afford him the supply he requires, so that there is no reason in debiting him with any "standing charges," but his bill for a year's supply may be simply—

240 × 365 = 87,600 units at sale price of 1d. per unit £365,

while the actual profit to the station would be here, as in the case of "A" above, 87,600 units at 0·2d. per unit = £73.

Thus the custom of these two consumers (who take an identical amount of current, with equal maximum demand) will be equally valuable to the central station if one pays at the rate of 3¾d. per unit and the other at the rate of 1d. The "maximum demand indicator" as usually installed is quite unable to differentiate between these two consumers, whose bills, based upon this system, would be identical.

In ordinary course of supply such a case is not likely to occur often, as so desirable a customer as "B" is not to be met with every day. A church, however, is upon exactly the same footing—though upon a much smaller scale—as its supply is taken on Sundays, when the station peak is a long way below its full capacity. Of course, should the church have a meeting room attached which it frequently uses for socials, tea fights, &c., upon week nights, a maximum demand indicator must be placed upon this circuit; but if this is not the case, it is perfectly legitimate to charge the church for current used, upon a basis of generating costs alone, with profit to the supply company (or corporation) and to the rest of the customers, to the same extent as if the church were supplied on normal terms, and required current at normal hours, *i.e.*, upon week evenings. There is, therefore, no suggestion of charity (which you, Mr. Editor, seem to infer) in supplying churches under these circumstances at specially low rates.

It is invariably the case that when a new system having decided advantages is introduced, it is extensively copied by many persons who have very little knowledge of the *rationale* of its use, and who consequently push it to absurd lengths; it is certain that plenty of stations using this indicator system would refuse to give the hypothetical customer B above mentioned any special terms, although that is a case where this system fails completely. That its author, Mr. Wright, should fully comprehend the limitations of the use of the maximum demand indicator is only to be expected, and hence, very naturally, he cuts these indicators out of circuit during the summer months. If the "peak" of the daily load during the summer time is well below the capacity of the supply station—*i.e.*, well below the winter peak—it must be the aim of every engineer to increase the load at *all* hours of the day as long as summer lasts, and to bring this peak as near as possible to the full capacity of the station. Electricity consumed in the summer time should, therefore, be charged only on a "flat" rate, to cover generating costs alone, the whole of the "standing charges" being borne by the winter consumers, who, like our hypothetical customer, "A," cause the enlargement of the *plant* without proportionate enlargement of *output*.

To be strictly correct—or, rather, more nearly correct—the indicator should be used in conjunction with a clock, which would put it in circuit only at the hours when the "peak" on the station amounts to its full working capacity, and keep it out of use as long as the station is working below comfortable full load. An approximation to this somewhat ideal plan would be to use clocks, such as those working in connection with the two-meter system, to put the indicator into the circuit at such hours as have been found by experience, at that time of year, to fully load the station, the hours being, of course, varied, both in duration and in time of day, according to the season of the year, and probably being *nil* for the whole of the summer. Whether in general the use of clocks, as suggested here, would be worth their expense is very problematical, but their use in certain cases, more particularly in connection with motor loads, ought to be beneficial. For instance, a small factory at Brighton would be charged for current upon the standard terms of 7d. for the first hour's use of their maximum demand, and 1d. afterwards, and probably quite rightly, as in the winter the factory will not have shut down till after the peak has arisen upon the station.

If, however, the manager of the factory knew that his demand indicator would not begin to register till (say) 4 o'clock in December, and 4.30 in January and November, he would probably find it pay him to have his plant shut down by these hours during these three months, so that he would pay for current at a flat rate of 1d., while the Corporation would find his custom no less profitable than at present. Brighton is far from being a manufacturing town, so that a plan such as this would not be of great utility there, but it ought to be worthy of consideration in many places. M. Chamen, in his address, showed that a motor load, as such, does not tend to fill up the hollows of the daily load curve, but only improves the load factor by raising equally both hill and hollow. An incentive, such as the one suggested here, to induce motor users to close down their premises before the peak came round, would, on the other hand, have a direct flattening tendency upon the load curve.

E. V. C.

Charlton, S.E., *July 6th*, 1901.

The Glasgow Tramway Power Station.

The attention of my company has been called to your report of the meeting of the Tramways Committee of the Glasgow Corporation, held on the 26th ult., which report appeared in your issue of the 5th inst., and I am instructed to inform you that the cranes which we supplied to the Corporation have been at work for some considerable time—one so long ago as from December 14th last. Although, in the erection of these cranes, we had been put to considerable inconvenience, and were delayed in the erection through the backward condition of the buildings, we, to facilitate the work of the Corporation, allowed them to be put to work before the completion of certain non-essential parts, and the cranes have therefore been satisfactorily in use for some time past. In fact, they have lifted the whole of the material that has been delivered and erected, and is now running in connection with the whole of the generating and auxiliary plant, weighing approximately 3,000 tons.

The Clayton Engineering and Electrical Construction Company, Limited,
M. Whiteley, *Secretary.*

July 6th, 1901.

The Leitner Battery.

Referring to the letter of your anonymous correspondent, "Pb O_3," in the Electrical Review of July 5th, I do not feel that I am at liberty, or that it would be interesting, to discuss the various "Leitner" patents with him through the medium of your columns, their validity and novelty have been thoroughly examined by competent persons.

My object in writing on June 21st was merely to establish the parentage or ownership of the battery that performed the long distance run of 94¾ miles on one charge, and that object—which is of importance and interest—has been attained.

Henry Leitner.

Street Lighting.

Mr. F. G. Clarke's request for information respecting the "fire-proof" glass mentioned in my last letter, is one which, under the usual circumstances, might be regarded as being, for trade reasons, not good policy for me to comply with, but inasmuch as the inner bulb forms but one out of many points in which I consider the "Stewart" lamp has outstripped its competitors, I will, with your permission, inform your correspondent that the glass in question is procurable from Mr. M. Bateman, of 9, Stonecutter Street, and is called by him "Monopel."

Douglas C. Bate.

London, W.C., *July 8th*, 1901.

Telephone Distributing Boxes.

Can any of your readers inform me of a good insulating compound for filling up such boxes—which composition shall neither shrink, crack, nor become brittle in course of years?

Cable Jointer.

The latter knows exactly what is wanted if he is

at 0·2d. per unit = £73 towards relief of rates, &c.

Calculation of Fly-wheel Effect.

I am greatly indebted to the editor for correcting several errors in an article of mine in last week's issue, on the calculation of fly-wheel effect. These errors were partly due to mistakes in typing, and partly due to incorrect translations from German into English, the remarks being a part of a German article by the author on a similar subject.

The factor $\left(\frac{\text{diameter of gyration}}{\text{diameter of gap}}\right)^2$ was given, since in practice it is often desired to find, from the actual weight of fly-wheel, the amount of irregularity in angular velocity which can be taken care of, in which case the weights of the different parts of the fly-wheel have to be reduced to the diameter at gap by the above expression.

In my remarks in your last issue, the inverse value was, of course, meant to be given.

H. S. Meyer.

Rugby, *July 6th*, 1901.

Forced Draught v. Steam Jet.

In Mr. Highfield's paper on "Refuse Destructors" at the recent meeting of the Incorporated Municipal Electrical Association, that gentleman advocated forced draught as being more economical than a steam jet. In the discussion which followed, Mr. Wordingham thought that if the use of steam actually resulted in the production of water-gas it had an advantage over forced draught. Another gentleman who proposed that the forced draught should be watered—in what manner he did not explain—also considered that the formation of water-gas was advantageous.

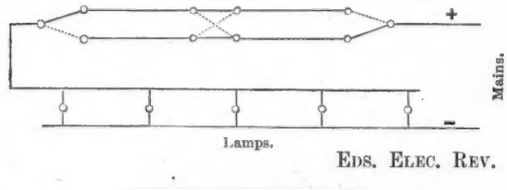
Now, sir, what happens in ordinary boiler firing. Is not the process gone through somewhat as follows?

Suppose an intensely hot bed of coke is lying on the grate bars; some shovelfuls of bituminous coal, much of it fine, are scattered evenly over the bed. The fine coal chokes the air spaces existing through the bed of coke, so shutting off the air supply needed to burn the gases produced from the fresh coal. Then there comes a rapid evaporation of moisture from the coal, a chilling process, robbing the furnace of heat. Next the formation of water-gas by chemical reaction, the steam being decomposed, its oxygen burning the carbon of the coal to carbonic oxide, and the hydrogen being liberated. This reaction takes place when steam is brought into contact with highly heated carbon; and it is also a chilling process, absorbing heat from the furnaces. The two valuable fuel-gases thus generated would give back all the heat absorbed in their formation if they could be burned, but there is not enough air in the furnace to burn them.

Can Mr. Highfield or Mr. Wordingham say whether better conditions exist in the furnace of a refuse destructor, than in a boiler, for the complete utilisation of water gas?

$$C + H_2O = CO + 2H.$$

Reply to "Doubtful."—Lamps on a staircase can be controlled from three or more points by the use of two-way switches at the ends and a reversing switch at each intermediate point, thus:—



Eds. Elec. Rev.

BOILER STAYS.

The recent explosion of a new boiler on the Lancashire and Yorkshire Railway is another of those occurrences, the cause for which it would be desirable to know, yet which appears doubtful. One witness for the company attributed the explosion to shortness of water, because a fusible plug had failed, but this is inconclusive. Fusible plugs may melt if covered with scale, but certainly if there were much scale, this fact should have come out. Another witness considered the water space too narrow, and that failure commenced at the bottom of the box, but he does not seem to have been much of an expert in locomotive boilers, being, in fact, a marine man, who did not even attempt to claim more than half-a-dozen entries inside a locomotive firebox. Faulty stays appear to have been the cause in the eyes of the coroner's jury, but whether because some were evidently broken before the explosion, or because of the want of heads, does not appear. Nor need we discuss that point. We wish to refer to the growing practice of putting in stays for water spaces which hold only by their screw threads. Now it is well known that if a plate thus held begins to bulge, such a stay will be apt to draw out of the plate very easily, even without its threads stripping. The action is peculiar, but it is well recognised. We believe this was the fault that caused, or helped to cause, the *Thunderer* explosion which occurred many years ago. It is argued that the plates of a locomotive boiler are stayed at such small intervals, about 4 in., that the fault cannot happen. This argument is all very well, so long as all the stays are sound, but it must be remembered that should one stay fail, there is a quadruple area now left without support, and we think that the use of headless stays is a matter not to be too freely entered upon. If a firebox fails at a corner, or at any part, the failure appears to spread rapidly, and result in explosion. This must be specially the case with boilers carrying a high pressure. Now it is not only when the boiler is whole that the stays should be safe from drawing through the plate. It is where failure has begun, and each row of stays is attacked in detail. As each row fails the next is attacked by the escaping forces and fails in turn, and the forces gather strength, each failing stay throwing its share of the load upon its neighbours. If all stays were well headed over, there would be much less risk of that first line of defence giving way, and the boiler might empty itself without serious explosion in the short time that the holding power of the stays hung out. But merely screwed stays cannot hold out. A failing boiler means a bulging plate, and a merely screwed stay cannot hold to this. Present day high pressures mean high temperatures, and these may signify considerable reduction of strength of materials, so that it is essential that all parts shall have a maximum of strength. Headless stays never have this in the sound boiler, and it is utterly lacking in the failing boiler.

It is suggested that other troubles with the locomotives in the same link may be evidence of the badness of the water. This, of course, may be true, but it does not demolish our argument *re* the heading of the stays; indeed, it rather emphasises the importance of such heading being always done. The absence of heads may be due to the material of the stays, which is an iron-copper alloy, less suitable perhaps than copper for heading over. This is an alloy of 62 of copper, 39 of zinc, and 6 of iron, and no doubt it is a stronger material than pure copper, but if it cannot be well headed, we think it faulty. We are strongly inclined to the belief that the heading is good practice, and ought to be continued.

THE LAUNCESTON ELECTRIC LIGHTING.

(From our Sydney Correspondent.)

The annual report of the working of the Launceston municipal electric supply station* during the year 1900 shows a considerable improvement on former years; the financial corner has been turned and a net profit shown for the year of £525, after paying all expenses, interest, and a contribution to the sinking fund. On the previous year's working there was a loss of £656, so that the increase of net profit is £1,181. The percentage of sinking fund to capital expenditure, a little over 1 per cent., seems low, and the total amount of the sinking fund £4,541, after four years' working is not too satisfactory, especially as there is a deficit of £1,981 on the former year's working which has not yet been wiped off. The capital expenditure has been increased by £7,165 during the year, and it is questionable whether some portion of this ought not to be charged to working expenses. Fair progress is shown in the use of motors, 34 motors, of an aggregate of 95½ H.P., being in use now, as against 20 last year of a total of 48½ H.P.; 13 consumers are using heating apparatus, principally radiators and irons, taking a total of 7·8 KW. The fact of the system being a single-phase alternating current supply materially interferes with the motor demand, owing to the difficulty of finding a satisfactory single-phase motor.

Owing to the large percentage of consumers being on the contract system, the revenue per unit sold is very low, 2·85d., though meter consumers pay 5·92d., and contract consumers 1·94d. One-third of the consumers are on contract, and they consume nearly three-fourths of the units sold. It is proposed to change over to an all-meter system as soon as possible, and for this purpose a supply of 500 Westinghouse meters is being obtained. Connections were made to 325 consumers, and extensions of street mains were made, and 12 new street lamps erected.

The wiring done is almost entirely by the municipal staff, and a certain amount of it is carried out on the hire purchase system; motors are also let out on hire or hire purchase. Following is a statement of accounts:—

Analysis of Accounts for Year ended December 31st.

1. Capital expenditure to December 31st	£98,794	£91,629
2. Revenue from lighting rate	£2,026	£1,991
3. Revenue from electricity supply	£5,734	
4. Revenue from rental of meters, motors and fittings, and other sources	£545	£4,423
5. Total revenue	£8,305	£6,414

* See Electrical Review, January 1st, 1897, for description.

demand, and 1d. afterwards, and probably quite rightly, as

years?

Cable Jointer.

6. Total costs	£3,339	£2,889
7. Gross profit before providing for interest charges and sinking fund	£4,966	£3,525
8. Percentage of gross profit to capital	5·21	
9. Interest on loans, less interest receivable	£3,477	£3,274
10. Sinking fund	£964	£908
11. Percentage of ditto to capital outlay	1·01	1·02
12. Financial result, after payment of all charges, including interest and sinking fund	£525	– £656
13. Capacity of dynamo, alternators, and arc machines in kilowatts	560	560
14. Maximum load reached, including arc lamps in kilowatts	440	365
15. Load factor	18·08	18·02
16. Number of 8 C.P. lamps connected December 31st (arc, incandescents, and motors equivalent in 8 C.P.)	24,626	19,419
17. Number of units supplied	696,700	576,243
18. Units sold per 8 C.P. lamp, connections during year being averaged	31·4	33·5
19. Price charged.—Private lighting	6d. & 3d. & 11s. per 8 C.P. per an.	6d. & 3d. & 11s. per 8 C.P. per an.
Power and heating	2d. & 1d.	2d. & 1d.
20. Average price obtained per unit, private supply	2·845d.	2·874d.
21. Average return from lighting rate per unit supplied for street lighting	2·285d.	2·310d.

Analysis of Cost.

	1900. £	1900. per unit. d.	1899. £	1899. per unit. d.
Generation and distribution costs—				
1. Oil, waste, and stores	68	0·023		
2. Wages of workmen	923	0·318		
3. Repairs and maintenance of buildings, plant, machinery, instruments, tools, mains, transformers, meters, fuses, &c.	1,253	0·432		
Works cost	2,244	0·773	1,829	0·762
General costs—				
4. Management expenses, Mayor's allowance, salaries, engineers department and clerical staff, printing, advertising, and general establishment charges	1,095	0·377	1,060	0·441
	£3,899	1·150d.	£2,889	1·203d.

Financial Result for 1900.

	£	£
Gross profit on year's working		4,966
Less: Interest on loans, less interest receivable	3,477	
Amount provided for sinking fund	964	4,441
Surplus for the year		£525

Detailed Technical Information.

	1900.	1899.
1. Capacity of alternators on 31st December, KW.	500	500
2. Capacity of arc dynamos, KW.	60	60
3. Total capacity of plant, KW.	560	560
4. Maximum load reached during year, private alternating	343	276
5. Ditto, private and streets, alternating, KW.	396	324
6. Ditto, arc lighting, private and streets, KW.	440	365
7. Number of consumers connected December 31st	1,136	806
8. Increase ditto during year	330	295
9. Number of 8 C.P. lamps private lighting, December 31st	18,971	15,083
10. Increase of ditto during year	3,292	3,391
11. Total metered units from station, alternating	850,929	670,634
12. Ditto, ditto, arc lamps	81,166	78,629
13. Total alternating current and direct	932,095	749,261
14. Calculated loss in transformers and mains	222,179	163,402
15. Total useful units	709,916	585,859
16. Used on works, light and motors	13,216	9,616
17. Total revenue bearing units	696,700	576,243
18. Used in streets, incandescent lamps	131,661	128,208
19. Total used in streets	212,827	206,837
20. Total to private consumers	483,873	369,406
21. Metered units, light and power	183,063	131,905
22. Contract consumers	300,810	237,501

Light by Contract and Meter.

	1900.	1899.
1. Number of consumers, total contract	386	302
2. Number of consumers, total meter	758	602
3. Number of 8 C.P. lamps, contract	4,946	4,009
4. Number of 8 C.P. lamps, meter	11,708	9,395
5. Charge for light, contract	£2,427	£1,778
6. Charge for light, meter	£2,998	£2,301
7. Revenue per lamp per annum, contract	9/9	8/11
8. Revenue per lamp per annum, meter	5/1½	4/11
9. Units used during year, contract	300,810	237,501
10. Units used during year, meter	121,643	93,664
11. Price obtained per unit, contract	1·94d.	1·80d.
12. Price obtained per unit, meter	5·93d.	5·90d.
13. Units used per lamp, contract	60·82	59·25
14. Units used per lamp, meter	10·39	9·97
15. Average hours burning per night, contract	5·55	5·41
16. Average hours burning per night, meter	0·95	0·91

Power and Heating.

	1900.	1899.
Power—		
Number of motors in use December 31st	34	20
Total aggregate horse-power	95½	48½
Average throughout the year	74½	—
Number of units used	56,896	—
Charge	£409	—
Units per horse-power	768·9	—
Price obtained per horse-power per annum	£5 10s. 7d.	—
Price obtained per unit	1·726d.	—
Average hours per annum	766·3	—
Cooking and Heating—		
Number of consumers	13	—
Power consumed in kilowatts	7·8	—
Total units	4,529·7	—
Charge	£30	—
Units used per kilowatt	580	—
Price obtained per kilowatt	£3 17s.	—
Price obtained per unit	1·593d.	—
Totals Power, Cooking and Heating—		
Units	61,420	38,241
Charge	£439	£264

BUSINESS NOTES.

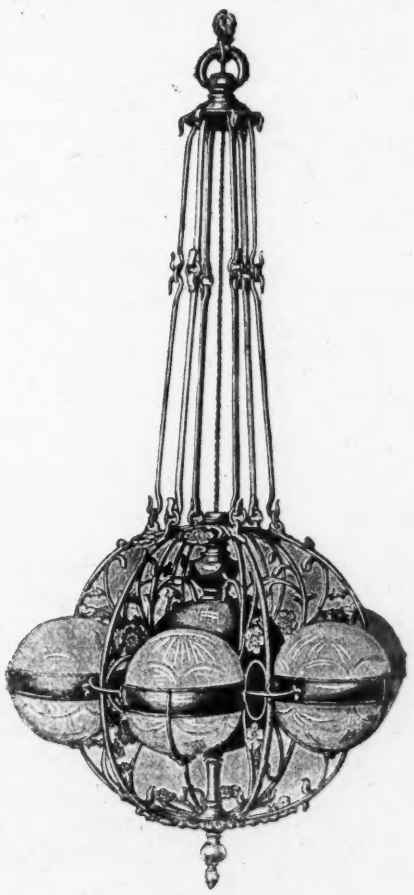
Electrical Wares Exported.

WEEK ENDING JULY 10TH, 1900.		WEEK ENDING JULY 9TH, 1901.	
Albany	Value £137	Antwerp	Value £48
Auckland	81	Auckland	80
Azores. Teleg. mat.	909	Bangkok	529
Bombay	178	Bombay	74
Buenos Ayres. Teleg. mat.	178	„ Teleg. mat.	114
„ Teleph. mat.	154	Buenos Ayres	1,100
Calcutta	234	„ Teleg. mat.	423
Cape Town	336	Calcutta	610
Christiania. Teleg. wire	86	„ Teleg. cable	404
Colombo	12	Christchurch	24
Copenhagen. Teleg. cable	809	Christiania	68
Durban	493	„ Teleg. mat.	50
East London	216	Colombo	31
Flushing	19	Copenhagen	19
Gibraltar	40	Durban	431
Hamburg. Teleg. mat.	1,350	„ Teleg. apparatus	188
Hiogo	1,466	East London	128
Malta	66	Flushing	21
Melbourne	251	Gothenburg	23
„ Teleg. cable	408	Hamburg	74
Port Darwin. Teleg. mat.	76	„ Teleg. mat.	80
Port Elizabeth	329	Hiogo	406
Rio Janeiro	149	Malaga	60
Sydney	558	Melbourne	228
Teneriffe	65	„ Teleg. cable	1,300
Valparaiso	115	Nagasaki	208
Yokohama. Teleph. apparatus	100	Rotterdam. Teleg. mat.	120
		Singapore	175
		Stockholm. Teleg. wire	144
		Sydney	941
		„ Teleg. wire	140
		Wellington	119
		„ Teleg. mat.	419
		„ Teleg. wire	2,646
		Yokohama. Teleg. cable	1,089
Total	£8,800	Total	£12,464

Foreign Goods Transhipped.

Stockholm. Teleg. mat.	Value £55
Trinidad. Teleg. apparatus	55
Total	£110

Art Metal Work at Glasgow.—The "Benson Pavilion of Art Metal Work" at the Glasgow Exhibition is a half-timbered building of white cement, designed by Mr. Benson, and very elaborately decorated within. The interior is used for showing a



LARGE PENDANT FITTING.

great variety of Benson work, but chiefly for electric fittings, these being tastefully placed for lighting the various rooms and porticos, not massed as in a showroom. The most striking object on view is a heavy gilt pendant hanging from the centre of the main vaulted

room, which was originally intended as a model for St. Paul's Cathedral. This has openwork arms or screens, which give a peculiar golden glow when the fitting is lighted up. The six soft globes of moulded Powell glass materially enhance the effect, and are, we believe, of the same kind as the glass recommended by Mr. Benson for St.

A ROOM IN THE BENSON PAVILION.

Paul's. The exhibit has been well patronised on account of its artistic merits and general attractiveness, but it is also worth the attention of electricians on account of its clever and tasteful lighting. Our illustrations show the interior of one of the rooms, and the pendant referred to above.

American v. English Machinery.—It is interesting to note, says the *Siam Free Press*, that competition is obviously waking up some at least of our home manufacturers. The last lot of locomotives obtained by the Burma railways were supplied by a well-known Glasgow firm at prices lower than any American firm tendered. They were delivered in Rangoon in a shorter time than American firms asked for. The engines from Glasgow are also, it is said, giving greater satisfaction than engines previously imported from America. Experience in Burma proves that although the latter are usually lower priced, they give out more quickly and need more fuel for the same amount of work.

Bankruptcy Proceedings.—The case of Johnstone, Benjamin & Co., manufacturers of electric wires and cables, Crown Electric Works, 10, Ascham Street, Kentish Town, came before Mr. Registrar Giffard last Wednesday at the London Bankruptcy Court, in relation to the debtors' application for a scheme of arrangement recently entertained by the creditors. The debtors failed last January, with total liabilities £8,116 3s. 11d. (unsecured £7,480 7s. 8d.), and assets valued at £5,912, and under the scheme they propose to pay a composition of 10s. in the £ by instalments extending over six months. A sum of about £4,644 will be required under the scheme, which, in the opinion of the Official Receiver may be regarded as calculated to benefit the creditors. Upon the case being called, Mr. Carrington, on behalf of the debtors, applied for a short adjournment. Only £2,000 of the required sum had been lodged, and he also desired further time to enable him to meet the charges contained in the report of the Official Receiver. Mr. Montague, for the trustee, consented to the proposed adjournment, and his Honour ordered the case to stand over until August 7th.

Bedford.—About 60 members of the Manchester Society of Engineers visited the works of Messrs. W. H. Allen, Sons & Co., at Bedford, on 27th ult.

Books Received.—"Duncan's Manual of Tramways, Omnibuses and Electric Railways," 1901. Twenty-fourth edition. London: T. J. Whiting & Sons, Limited. 5s.

"The Engineer or Architect as the Arbitrator between the Employer and the Contractor," by C. C. Gregory. London: William Clowes & Sons, Limited. 1901.

"International Exhibition Plan of Glasgow." Glasgow and London: W. & A. K. Johnston, Limited. 6d.

"Pocket-book of Electrical Engineering Formulæ," by W. Geipel and M. H. Kilgour. London: The "Electrician" Printing and Publishing Company, Limited. 7s. 6d.

"The Glasgow and West of Scotland Technical College Calendar for the Session 1901—1902." 1s.

Catalogues and Lists.—Messrs. Johnson & Phillips have brought out a new abridged list (No. 10) of their single carbon arc lamps. Revised prices of carbons are also given.

An illustrated catalogue of joints for expansion and contraction in steam pipes, has been sent to us by Messrs. John Wilson & Co., of Lime Street, E.C., who are the London agents for the manufacturers, Messrs. Shipman & Co., Limited, of Trinity Brass and Copper Works, Hull.

Messrs. Baker & Co., of Newark, N.J., are circulating the ninth edition of their catalogue, in which they give data concerning platinum and platinum ware.

Messrs. Atkinson, Schmahl & Co., of Newcastle and Manchester, send us a copy of their trade price list of main switches, detailing quick break, change-over, charging, battery, voltmeter and other switches; also fuse blocks, cut-outs, &c.

Dissolutions of Partnerships.—With reference to our notice of the dissolution of partnership between Messrs. Palmer and Watson, we understand that Mr. Duncan Watson is now the sole proprietor of the business, and will continue to trade in the name of Palmer & Watson at the same address (100, Charing Cross Road). The firm has some good work in hand.

Messrs. A. Baxter and T. H. B. Wray (Baxter & Wray, electrical engineers, Macclesfield Street, Shaftesbury Avenue, W.) have dissolved partnership. Mr. Baxter will attend to debts.

A meeting of the Hiram S. Maxim Electrical Corporation, Limited, is to be held at Gillingham Street, Victoria, on August 6th, to hear an account of the winding-up proceedings.

Notice is given of a first and final dividend of 1s. 10¾d. in the Electric Exploitation Company, Limited, of Walbrook, E.C.

Electricity on the "Deutschland."—From the Electrical Company, Limited, we have received a brochure in which appears an illustrated description of the electric light and power installation on board the fast mail steamer *Deutschland*, of the Hamburg-America line. The electrical equipment was supplied by the Allegemeine Elektricitäts-Gesellschaft, of Berlin. Numerous pictures are given showing the plant and machinery installed, and the kind of fittings in use. In addition to the lighting, there are 23 electric motors, more than half of which drive ventilating fans in the lower rooms of the vessel. Small elevators, a kneading machine, two repair drills are also driven by electric motors.

Fined.—A conductor on the Central London Railway, under notice to leave, thought he would "have a lark" before leaving the service, so during the progress of a train from Shepherd's Bush to Bank, and also during the return journey, he operated the emergency brake in his car, and slowed the train down between the stations at his will. On one occasion the brake was put on so strongly between the stations that the train came almost to a standstill. The brake was applied as the train was approaching the Bank terminus, and when it was released the train ran quickly—almost too quickly—into the station. Altogether, 40 minutes' delay was caused. This not only affected the train upon which the prisoner was engaged, but temporarily "threw out" the entire system. When the case was heard at Bow Street, prisoner denied the offence, but the magistrate found it proved, and imposed a fine of £10.

For Sale.—Messrs. Percy Huddleston & Co. will on Monday, July 15th, sell without reserve a quantity of electrical apparatus at Clapham Road (*re* Barclay & Co.). On July 18th they will sell by auction a quantity of electrical apparatus and fittings at Long Millgate, Manchester. Particulars of these sales appear among our advertisements to-day.

Glasgow Exhibition.—We read in the *Scotsman* that last Saturday week about 1,000 of Messrs. Mather & Platt's workers paid a visit to the Glasgow Exhibition.

Royal Assent.—The following Acts have received the Royal assent:—

Falkirk and District Tramways Order Confirmation Act, 1901.
Electric Lighting Orders Confirmation (No. 2) Act, 1901.
Electric Lighting Orders Confirmation (No. 3) Act, 1901.
Electric Lighting Orders Confirmation (No. 4) Act, 1901.
Gateshead and District Tramways Act, 1901.
Bury Corporation Tramways Act, 1901.
City and South London Railway Act, 1901.

The Canadian Niagara Power Company.—Residents of the Province of Ontario are rejoicing because Premier Ross's government has succeeded in making a supplemental agreement with the Canadian Niagara Power Company, whereby that company has agreed to make an expenditure of $1,500,000 within two years, or as much sooner as may be possible, in the development of the power of Niagara on the Canadian side. At a recent annual meeting of the company arrangements were made for the complete development of the first installation of the works of the company, comprising a tunnel of 100,000 H.P., an inlet canal and a tunnel tailrace of 50,000 H.P. capacity, together with the installation of electrical and hydraulic machinery to produce 25,000 E H.P. Proposals for the machinery have already been invited, and it is natural to suppose that if the Canadian manufacturers can make the necessary machines, the contract will be awarded in the Dominion. All things connected with the prospective development having now been arranged on a satisfactory basis, the work is expected to go right ahead. During recent years opponents of the present Government have been so antagonistic to Niagara interests that they have repeatedly called for a forfeiture of the franchises, thus rendering American capital most timid. On the present satisfactory basis, Canadian Niagara should have a magnificent power plant in two years.

Trade Announcement.—The new Brotherton Tube Company, Limited, of Wolverhampton, have appointed Mr. James Gray, of 19, Waterloo Street, Glasgow, as their sole agent for Scotland for the sale of their enamelled steel conduit tubes and fittings. A stock of these is to be kept at Glasgow, Edinburgh and Dundee.

Tramway Manual.—The 1901 edition of Duncan's "Manual of Tramways, Omnibuses, and Electric Railways," is now out. Its somewhat belated appearance is due to the determination of the editor to, as far as possible, include all tramway accounts for 1900. Even this delay, however, has not inclined some tramway officials to lend the editor of "Duncan's Manual" their co-operation in helping to make the book complete. A list of the new accounts included in, and the old ones which have been omitted from, the present edition, appears in the preface. The accounts of the different systems for the years 1899 and 1900 are arranged in convenient reference form.

Tramways and Plant for Sale.—In our advertisement pages to-day full details are given of the Isle of Man Tramways and Electric Power Company's undertakings, which are now being offered for sale in three lots.

The St. Helens E.S. and Tramway Committee is offering for sale one 120-KW. steam alternator (Robey-Johnson & Phillips), a Ferranti switchboard and instruments, eight 21-KW. transformers, steam piping, &c., which have been employed at the Warrington Road Works since 1896.

ELECTRIC LIGHT AND POWER NOTES.

Aberdeen.—The Docks and Pilotage Committee of the Harbour Board have resolved to recommend that an honorarium of 50 guineas be voted to Mr. J. A. Bell, electrical engineer, in recognition of his services in superintending the erection of the electric light installation on the quays.

Austria.—A central electric lighting station has lately been completed in the town of Gmünd, the feature of which is that the plant is driven by gas engines operated by means of producer gas. The electrical part of the work was carried out by Messrs. Egger & Co., of Vienna, and the gas engines and gas-making plant by the Skoda Company, of Pilsen.

Aylesbury.—The B. of T. has agreed to defer consideration of the question of the revocation of the electric lighting order for 12 months from the present time.

The Electrical Power Distribution Company has given notice of its intention to apply for a prov. order to supply electricity within the urban district.

Barrow-in-Furness.—A L.G.B. inquiry was held on Tuesday respecting the borrowing of £12,340 by the Barrow Corporation for additional electricity works, to provide new street and private lighting for the coming winter at Vickerstown, Walney Island. The cost of carrying the electricity mains across Walney Channel will be slightly over £6,000.

Beckenham.—On Thursday, July 4th, the members of the Urban District Council's Association, who have been holding their annual conference in London, visited Beckenham and inspected the electric lighting and dust destruction works. Mr. Blake, chairman of the Electric Light Committee of the Beckenham Council, stated that although the light had been in use for about seven months, the number of lamps was about 13,000, and the demand had necessitated the increase of the plant. In order to enable this to be done an application had been made for a new loan of £20,000.

Belfast.—The electric light accounts for the year ended March 31st, 1901, show a gross revenue for the year of £7,760, and after paying interest and redemption a net surplus of £472. This sum, with the balance brought forward from last year of £2,655, made a total revenue at the revenue account of £3,127. The T.C. decided to write off £2,000 for depreciation on gas engines at Chapel Lane, and to carry the balance to the credit of renewals suspense account. It was resolved that from July 1st the price of current for motor and heating purposes be reduced after the first hour's use of the consumer's maximum demand from 1½d. to 1d. per unit. The L.G.B. has sanctioned the loan of £90,822 in connection with the electric light undertaking.

Bermondsey.—The electricity works will be completed by October, when the Borough Council will be in a position to supply electricity for lighting and power purposes. The Council has decided to adopt the maximum demand system with an initial charge of 6d. per unit for an average use of one hour per day throughout each half-year, and 3d. per unit for all excess consumption. A uniform rate of 3d. per unit will be charged for church and chapel lighting.

Bootle.—The first annual report of Mr. W. R. Wright, the borough electrical engineer, shows that in March last there were 107 public arc lamps and 562 16-C.P. incandescents; private incandescent, 13,710; increase 3,750 on last year's figures. The number of cars working on the Bootle lines was 55. Approximately, about 2,000 units are consumed per day.

Bray.—The U.D.C. has resolved to ask the L.G.B. to sanction a loan of £4,200 for the purpose of extensions necessary in consequence of the increased demand for electricity.

Brentford.—The proposed application for a prov. order by the Provincial Electric Supply and Traction Company will be opposed by the U.D.C.

Bristol.—Mr. A. G. Bird, having been appointed engineer and manager to the Guernsey Electric Supply Company, has resigned his appointment as assistant electrical engineer. Mr. H. H. Couzens, who now occupies the position of third assistant engineer, at a salary of £156 per annum, has been promoted to be second assistant engineer, at £200 per annum; and J. H. Bolam, B.Sc., at £156 per annum, has been promoted to be third assistant engineer, at £175 per annum.

Carnarvon.—We understand that Mr. Peterson intends to apply for powers to supply electricity for lighting and traction throughout the county of Carnarvon.

Cresswell.—The L.G.B. has declined to sanction the loan of £1,500 for the purpose of installing the electric light in the village, the grounds for refusing being that the Parish Council could not manufacture and generate the electricity.

East Molesey.—The U.D.C. has decided to apply for a prov. order. It is proposed to transfer the order to a company.

Elland.—At the monthly meeting of the District Council the Electricity Committee recommended that the tender of Messrs. Meldrum for a destructor be accepted, and that the scheme of Mr. Emmett for an electrical installation be approved. After considerable discussion the minutes were confirmed.

France.—The Municipal Council of Dijon have just accorded to the Société Dijonaise d'Electricité an extension of concession till December 31st, 1943, with permission to run its wires overhead or underground. A large reduction in the price of current has been made to the town.

The French Minister of the Marine has recently approved of the contracts regarding the lighting of the arsenals of Toulon and Bizerta. These two important installations will be confided, one to the Société "l'Eclairage Electrique," 27, Rue de Rome, Paris, the other to Messrs. Decauville, of Petit-Bourg, near Paris. The high-speed engines and steam generators will be furnished by Messrs. Delaunay-Belleville, of Saint Denis-sur-Seine.

Fire.—Last week, while some workmen were removing wooden blocks from the roadway in Little Newport Street, Charing Cross Road, an iron spike was driven in too far, piercing the electric lighting cables. These immediately fused and the coverings of three joint boxes were blown off. Fortunately, no one was injured. The fusing of the wires spread rapidly, and at different points in Charing Cross Road smoke began to issue from the gratings and manhole boxes. Two fire engines were quickly on the scene, and a large number of police were brought up. The workmen were set to work to pull up the roadway over the cable in Little Newport Street. Traffic along the adjacent pathway was stopped.

Hexham.—The Northern Counties Electricity Supply Company, Limited, has given the Council notice of application for a prov. order to supply electricity within the Urban District of Hexham. A similar notice was received from the Electrical Power Distribution Company, Limited.

Ilfracombe.—The Council having disposed of their electric lighting order to the Edmundson Company, the decision to spend £14,000 on the works has been rescinded. The company is expected to commence operations shortly.

Kimberley.—Under the heading "A Huge Electric Scheme for Kimberley," the *British and South African Export Gazette* states that it hears from "an authoritative source" that "the directors of the De Beers Consolidated Mines have practically completed the arrangements for a great extension of their electric light and power system, which will make it the largest installation of the kind in South Africa, and one of the largest in the world. In addition to the present lighting of the whole of the over and underground workings of the Kimberley and De Beers mines, and the use of electricity as a motive power for the machinery, the Wesselton and other mines controlled by this great corporation are to be connected in the same manner, the power for which will be supplied from the present central station, which is to be greatly enlarged to accommodate the powerful dynamos and other necessary machinery that will be required. In addition to lighting the mines, the company will, we understand, take over the existing plant of the Kimberley Municipality, and supply the Town Council at net cost, which will be greatly below the present price, thus saving the ratepayers a large sum yearly." The De Beers Company have always shown great public spirit, but our contemporary learns with regret "that it is probable the huge orders for machinery, &c., which their scheme involves will probably be placed in the United States, owing, it is alleged, to the greater suitability of American plant for mining operations."

Leeds.—The C.C. has lowered the maximum price for electrical energy for lighting to 4d. per unit, and for power 2d. to 1½d., according to the nature of the load, or, as a local paper says, "according to the rate at which each horse-power ran!"

Lewes.—Last Tuesday evening Lewes, for the first time, was put in possession of an electric light supply. The Electrical Power Distribution Company, who took over the provisional order granted to the Corporation, laid their mains through the principal streets, and have erected works fronting the River Ouse. The plant includes two Babcock water-tube boilers. There are also two sets of engines and dynamos, the former being Raworth's Universal, and the latter Mordey's patent. At the inauguration ceremony the current was switched on by the Mayor (Councillor Holman).

Leigh.—The Tramways and Electricity Committee at their last meeting instructed the town clerk to make application to the L.G.B. for sanction to the borrowing by the Council of £11,250 for electricity works extensions. The engineer, Mr. J. Foster, was instructed to prepare plans, sections, and specifications, and to obtain tenders for such of the extensions as he may deem immediately necessary.

Limerick.—The B. of T. has deferred consideration on the question of revocation until November, 1902. The Corporation asked for an extension until 1906.

Liverpool.—At last week's meeting of the City Council the proceedings of the Electric Power and Lighting Committee were confirmed. These included a recommendation that a contract should be entered into with Messrs. Willans & Robinson, Rugby, for the supply of three sets of plant at the Lister Drive station for the sum of £6,939 per set, less 2½ per cent.

The Brownlow House Workhouse officials are looking into the cost of lighting the workhouse chapel electrically.

London.—St. Pancras.—On Monday last at the Town Hall, Pancras Road, N.W., a conference was held *re* plans of electricity mains, &c., required to be furnished to the Postmaster-General. The agenda read thus:—

To consider the recent requirements made by the Postmaster-General with regard to being supplied with plans on cloth to a scale of not less than 10 ft. to the mile, showing the position of mains, &c., laid in the public thoroughfares.

To approve of a representation being made to the Postmaster-General, pointing out the difficulties in complying with his request, and asking for a modification of his requirements.

Manchester.—The Electricity Committee of the Manchester Corporation last week made a tour of inspection of works connected with the street mains department of their undertaking. Then they viewed the adjoining works in progress at the Bloom Street station. The first 1,800-kw. generator has been delivered on the site there, and the erection of the machinery is in progress. The programme included a visit to the buildings at Ardwick, which are nearing completion, cable laying in Tower Street, Moss Side sub-station, Rusholme high pressure continuous current transforming and balancing sub-station, and the inspection of the laying in Wilmslow Road, Fallowfield, of extra high pressure three-phase cables, &c. The total mileage of mains laid up to March 31st was 159¼ miles, at an expenditure in Manchester of £422,111, in Withington of £38,487, in Moss Side of £18,804, and in Levenshulme of £2,630, making a total of over £482,000. The quantity of electricity accounted for during the past year amounted to 7,944,540 units. There are at present on the books 3,786 consumers, and the total maximum demand is equivalent to 386,770 8-c.p. lamps.

Market Harboro'.—The Provincial Electric Supply and Traction Company has given notice of its intention to apply to the B. of T. for a prov. order to supply electricity in the Harboro' Urban District. The Council will oppose the order.

Merton.—At their next meeting the Parochial Committee will consider a proposal for the electric lighting of the village, the owners of Polytechnic Building Estate having applied for leave to obtain a supply of current from the Wimbledon U.D.C. mains.

Montrose.—The Corporation electricity works, which have been erected by and are in the hands of the Edmundson's Electricity Corporation, commenced operations last week. In addition to the street lighting, there are about 2,000 8-c.p. lamps connected. The total capital outlay amounts to about £25,000.

Nelson.—The T.C. has decided to apply to the L.G.B. for sanction to a further loan of £25,000 for a new electric lighting station at the refuse destructor site, and the equipment thereof.

Newburn.—The Newcastle and District Electric Lighting Company and the Provincial Electric Supply Company are seeking powers to supply electrical energy in the Newburn district.

New Malden.—The U.D.C. has appointed a deputation to wait upon the Wimbledon U.D.C. regarding a proposal to light the village from an extension of the Wimbledon electric mains.

North Berwick.—A plebiscite is to be held respecting the proposed agreement with Messrs. Crompton & Co., as to the introduction of electric lighting into the burgh.

Northfleet.—The Tramway Company has been invited to submit terms for supplying electric energy to the Council.

North Metropolitan District.—At the last meeting of the Tottenham D.C., the members discussed the expediency of sending delegates to another proposed joint committee of representatives of the Edmonton, Enfield, Southgate, Wood Green and Tottenham Councils to consider the question of producing electricity for use in their respective districts. The matter arose on a report of the conference held at Wood Green on the subject of a joint electric power scheme, when it was agreed that the public interests demanded that the generation and supply of electricity should be in the hands of local authorities rather than of private companies, and that it was desirable that a committee of representatives of the several parishes should be reappointed. An amendment was carried that the Council should not join with any committee until their application for a provisional order had been decided.

The Edmonton District Council, at their meeting on Tuesday night, decided to apply for a prov. order for electric lighting.

Norwich.—The electricity company having applied to the T.C. for leave to double the supply pressure, the Council is considering the advisability of offering to purchase the undertaking, and has obtained a report from Mr. W. C. C. Hawtayne, in which the purchase is recommended.

Rochdale.—A sub-Committee which had been appointed to make inquiries as to Mond gas, has reported to the T.C. that under the present conditions the Committee hesitated to recommend its adoption as a motive power for generating electricity at the electricity works.

Surbiton.—A L.G.B. inquiry was held on Tuesday as to the U.D.C.'s application to borrow £50,000 for electric lighting purposes. The Council obtained their prov. order in 1891, and a provisional agreement has been made for the establishment of a generating station with the Callender Cable Company. The company will pay all charges on the capital outlay, and the Council has the option of taking over the undertaking after five, seven and a half or 10 years. The Council, however, will have to take over the works if the company should not find the undertaking profitable. A central site for a generating station has been selected, and the works are designed to start with plant for 10,000 8-c.p. lamps.

South Africa.—It is anticipated that very shortly the Natal Government will be in the market for electric light and power machinery in connection with the Durban Harbour works, also that orders amounting to about £100,000 may be given out by the Cape Town Council.

South Shields.—The latest financial report on the Corporation electric lighting for the half-year ended March 31st, shows a net profit of £2,802, and after wiping off the debit on the previous half-year, there is still a credit balance of £1,678. The revenue was £8,147. The borough accountant, Mr. J. Bridge, in submitting the report, reminds the Corporation that there is as yet nothing written off for depreciation, but thinks that this might be well left for future consideration.

The Council has decided that the price of electric current for lighting purposes shall be 7d. per unit for the first hour's use of the maximum demand, and 2d. per unit beyond that amount; the change to take place as from October 1st.

Teignmouth.—The Provincial Electric Supply and Traction Company has given notice to the D.C. of its intention to apply to the B. of T. for a prov. order for the supply of electricity for public and private purposes.

Tonbridge.—The Electric Supply Company of Kent has given notice of application for powers to supply electricity to Tonbridge, and the D.C. has decided to give notice of opposition.

Wakefield.—At the last Council meeting a resolution was adopted rescinding that part of a minute passed at the previous meeting relating to the payment to the city electrical engineer of a bonus on all completed work on capital account.

Wimbledon.—A L.G.B. inquiry was held last Friday on a proposal to borrow, *inter alia*, £7,500 for electric lighting extensions. There are already no less than 110 miles of electric cables laid in the district. The cost of private lighting is 5½d. per unit.

Worcester.—The Corporation is about to erect a second generating station in the city, separate from that at Powick, where the water-power of the Teme is used. The existing station is overtaxed, and the Corporation has undertaken to supply power to the electric tramways now projected; hence the need of a second station. The City Council has instructed the engineer (Mr. Sutherland) to prepare a specification and obtain tenders for the machinery and plant required. There are to be three large engines, each of 350 h.p., two of them driving one dynamo each for traction, and the third driving two dynamos for lighting. Either of the traction plants can be used as a reserve for lighting. There is also to be provided a special set, consisting of engine, dynamo and alternator, which will be used to help the Powick plant when short of water, and to charge batteries, and thereby store the water-power when there is plenty of it. The batteries will then be used during the evening. Three boilers are to be installed, and space is left for a fourth. The boilers will be fitted with mechanical stokers, and economisers will be fixed.

Yeadon.—The Provincial Electric Light Supply and Traction Company has informed the D.C. of its intention to apply to the B. of T. for a prov. order to supply electricity for public and private purposes within the Council's area.

ELECTRIC TRACTION NOTES.

Aberdeen.—A new electric car route was opened on 4th inst.

Cork.—The County Council has refused to grant the General Electric Company of Ireland, Limited, its approval to proposals to run certain light railways and tramways near Middleton and Ballinacurra.

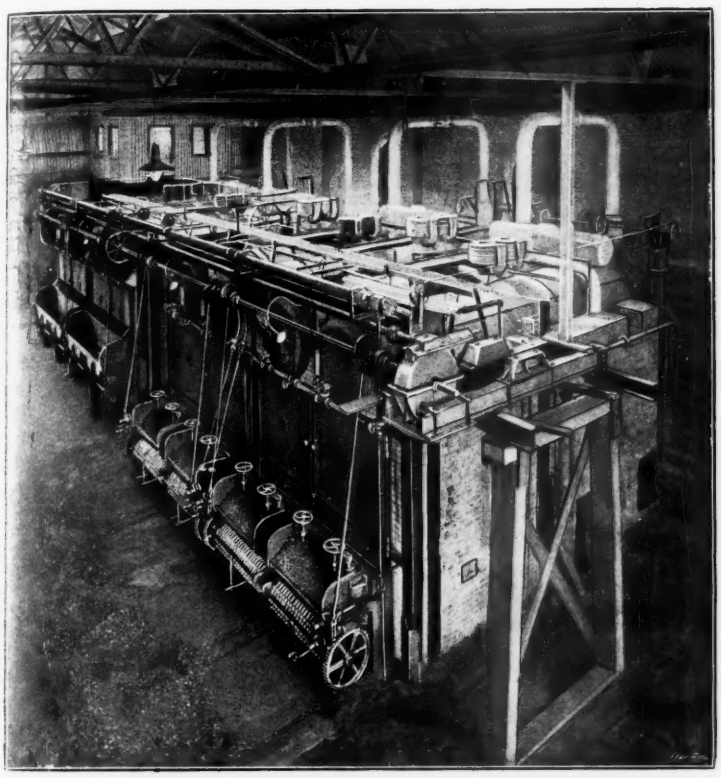
Crewe.—The T.C. is to oppose the granting of an order to the British Electric Traction Company, Limited, for the construction of light railways in Crewe. The Council is renewing its application of November last for powers to construct and work a light railway on its own account.

(Continued on page 67.)

ELECTRIC POWER SUPPLY ON TYNESIDE.

(*Continued from page* 23.)

Boilers.—The present boiler equipment is divided into four sections, each section consisting of two Babcock and Wilcox boilers arranged in one battery, and working at a pressure of 200 lbs. above the atmosphere. Each boiler has a heating surface of 4,020 sq. ft., and will evaporate 14,000 lbs. of water per hour.



Babcock & Wilcox Boilers.

Variable feed mechanical stokers are fitted throughout, as well as Babcock and Wilcox superheaters, the latter being designed to impart a superheat of from 100° to 120° F. to the steam.

With the exception of the dead-weight safety valves and the low-water alarm, which are of Turnbull's make, all the mountings are Dewrance's, while, in addition to the usual fittings, the boilers are provided with double blow-off cocks in series, duplicate feed valves, and fixed soot-cleaning gear.

At the back of each stoker are fixed automatic dumping bars, so arranged that the ashes are discharged down a chute into a truck in the ash tunnel, at the end of which an elevator is provided.

The remainder of the boiler house equipment for the first section of boilers consists of a 280-tube Green's economiser and two "Rankine" feed-water filters.

All exposed portions of the boilers are covered to a depth of 2 in. with magnesia non-conducting composition, bound on with canvas, and a further covering of lead is provided on the top of the steam drums and other portions liable to mechanical injury.

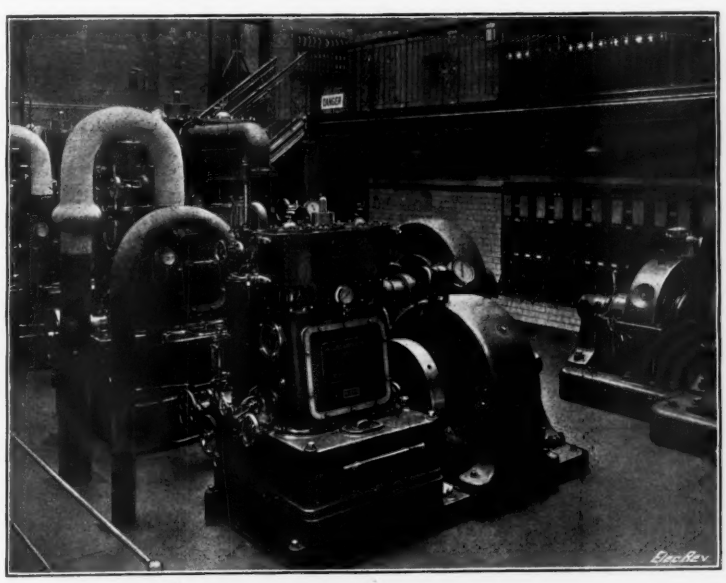
Piping.—The steam piping system has been kept as short and simple as possible, the boilers being arranged symmetrically with regard to the main engines. One boiler is sufficient to drive a 700 KW. set at normal load.

All steam pipes are of solid drawn steel tube with screwed or rivetted wrought-steel flanges, both tees and valves having cast-steel bodies. All tees of 5 in. and over are, however, made up by rivetting a branch pipe directly to the main. Each of the boilers is connected through two valves to the main 7 in. header which extends the whole length of the boiler house; the valves in this header are so arranged that the boiler and engine plant can readily be split up into a number of complete units, each engine being fed from the boiler immediately behind it.

In addition to this main header, there is a smaller pipe running along the whole length of the boiler house, about 6 ft. above firing level, from which the feed pumps and Belliss sets are supplied.

The main header is divided into halves by an inverted **U** expansion piece, each half being anchored at the middle point of its length, so that from this poin it is free to expand in both directions, the weight being taken by long hangers.

The whole of the steam valves are of Hopkinson's full-way type, and all valves above 6 in. diameter are being provided with bye-passes. Drain pockets are provided on both main and branch steam pipes, and these discharge through Geipel traps into the hot-well. The covering is the same as that used on the boilers, and is provided for both steam and hot-feed piping.



Belliss-B.T.H. Direct Current Sets.

F

night, decided to apply for a prov. order for electric lighting.

(Continued on page 67.)

Engines.—In order to drive the direct current exciting and local power circuit generators, of which there are about 450 KW. installed, three Belliss sets are provided, two each of 300 B.H.P. and one of 75 B.H.P. These are all of the compound two-crank type, the largest sets running at 380 r.p.m., while the 75 H.P. set runs at 500 r.p.m. They exhaust through two Klein grease separators into a Wheeler surface condenser placed in the engine room basement, an automatic atmospheric valve allowing them to exhaust into the atmosphere should the necessity arise.

The engines driving the 700-KW. sets are all of Tyneside manufacture, of the triple-expansion vertical inverted type, *i.e.*, practically marine engines, fitted with governors and modified valve gear. The first of these was constructed by the Wallsend Slipway and Engineering Company, and the others by Messrs. Wigham, Richardson & Co.

The three cylinders of the Slipway engine have diameters respectively 17½ in., 28½ in. and 48 in., with a stroke of 36 in.

They are steam jacketted throughout, and fitted with Corliss valves, all positively driven except the steam valves on the high pressure cylinder, which are trip valves closed by spring dash pots and controlled by a chain-driven governor of the Proell type. The normal speed of the engine is 100 r.p.m., and an Aspinall governor mounted on the rocking air-pump lever shuts off steam when the speed rises above 115. The fly-wheel, generator shaft and bearings are also supplied by the engine builders. The bearings are self-adjusting to provide against any want of alignment of the shaft. Lubrication is provided by means of an oil pump, worked from the end of the shaft, and delivering oil under pressure through oil ways of special design. Water service is also provided for use in case of emergency. An expansion governor is provided which, when running, allows for adjustment by hand of 5 per cent. either way from normal speed.

The governor and fly-wheel specification provides that the engine shall not race or hunt under any conditions of load. The steady speed is not to vary more than 2 per cent. above or below the normal under any conditions of load, and the maximum variation of speed when the load is thrown off is not to exceed 5 per cent.

The air pump is driven by a rocking lever off the high pressure crosshead, while the centrifugal circulating pump is placed in the basement underneath and driven by a direct current motor.

The surface condenser is supported on the back framing of the engine columns, an automatic valve being provided, so that, in the event of the circulating water failing, the low pressure cylinder may exhaust into the atmosphere. The engine will, when on the atmosphere, drive the generator at full load (700 KW.), and will also in these conditions fill the specification as to governing and angular velocity.

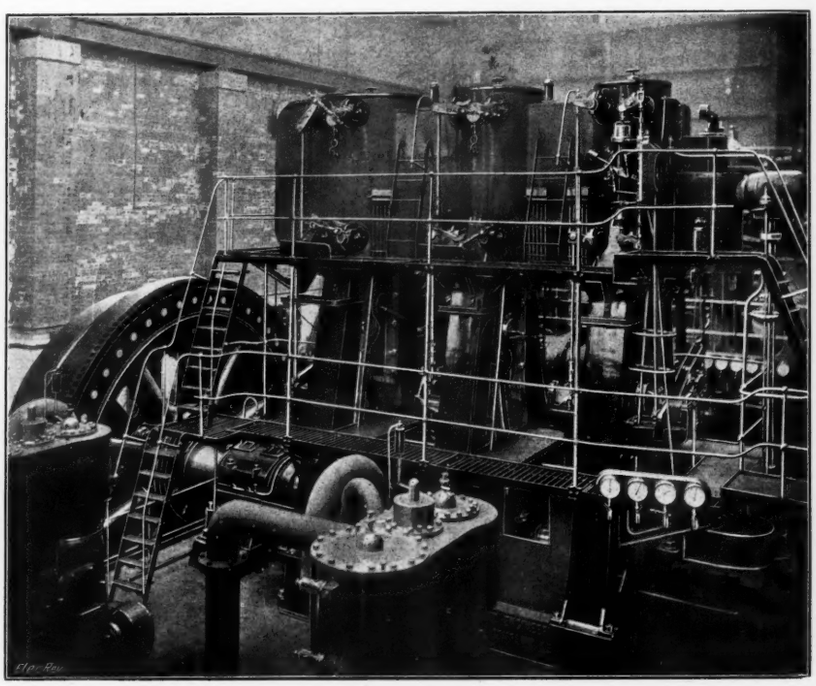
The three Wigham-Richardson engines are designed to a specification similar to that of the Slipway set so far as output, speed, atmospheric exhaust, angular velocity, governing, &c., are concerned. They are also self-contained, with surface condenser, direct-driven Edwards air pump, Aspinall's emergency governor, and motor-driven centrifugal pump, but in other respects they present certain novel features. They have four cylinders (two low pressure) of diameters 19 in., 31 in., 34 in. and 34 in., with a 36-in. stroke. The four cranks are not set exactly at 90°, but are balanced on the Yarrow, Schlich & Tweedy system, the object being to do away with all vibration, and to secure even turning moment without the use of a heavy fly-wheel.

The engine is controlled by a governor of the fly-wheel type (Stumpf's patent) mounted direct on the crankshaft.

Station Power System.—The electrical system of the power station has been designed to give the maximum possible security against breakdown or accident, combined with the most simple arrangement consistent with this.

All direct current circuits are supplied at 240 volts, and where the three-wire system is employed, the pressure is 240 volts on each side. The direct current sets all generate at from 240 to 260 volts, and can be put on to any circuit.

From the station power board separate circuits are run to the individual motor panels, each motor being controlled by its own panel; these, in the case of the river pump, the air compressor and the circulating pump motors, are fixed in the centre of each buttress spacing, and are provided each with two single pole switches and fuses, ammeter, starting and regulating rheostats. All these panels are placed some 12 in. from the wall, and are carried on hinged angle irons, so arranged that they can be swung from a vertical to a horizontal position to allow for any examination or repair that may be necessary.



WALLSEND SLIPWAY AND ENGINEERING COMPANY'S ENGINE COUPLED TO B.T.H. 700-KW. THREE-PHASE ALTERNATOR.

Large Alternators.—These are of the three-phase type with revolving fields and stationary armatures, and were supplied by the British Thomson-Houston Company, Limited. Each machine is placed tandem to its engine, the field being mounted on an extension of the engine shaft 24 in. in diameter. The armatures are arranged to slide parallel to the shaft on base plates secured to the foundations by bolts.

The normal output of each generator is 700 KW. at 5,500 volts, the speed being 100 revs. per minute. The fields have 48 poles, thus giving a frequency of 40 cycles per second. The armature core is built up of punchings of the best soft grade sheet iron specially selected for high permeability and low hysteresis. They have been japanned before assembling, and are further insulated from one another by sheets of paper inserted to reduce the eddy current loss. Slots are punched on the inner side to receive the winding, which is held firmly in place by means of wooden wedges. The punchings are assembled with ventilating spaces at

intervals to allow of a free circulation of air in direct contact with the core and winding.

The armature winding consists of separately insulated former-wound coils laid in the slots and secured therein by the above-mentioned wooden wedges, the coils being completely insulated before being placed in the armature. The winding is so arranged that, in case of a burn-out, the defective coil can be readily taken out and another put in its place. There is one slot per pole per phase, and the shape of the pole-pieces is such that the wave shape approximates closely to that of a sine curve.

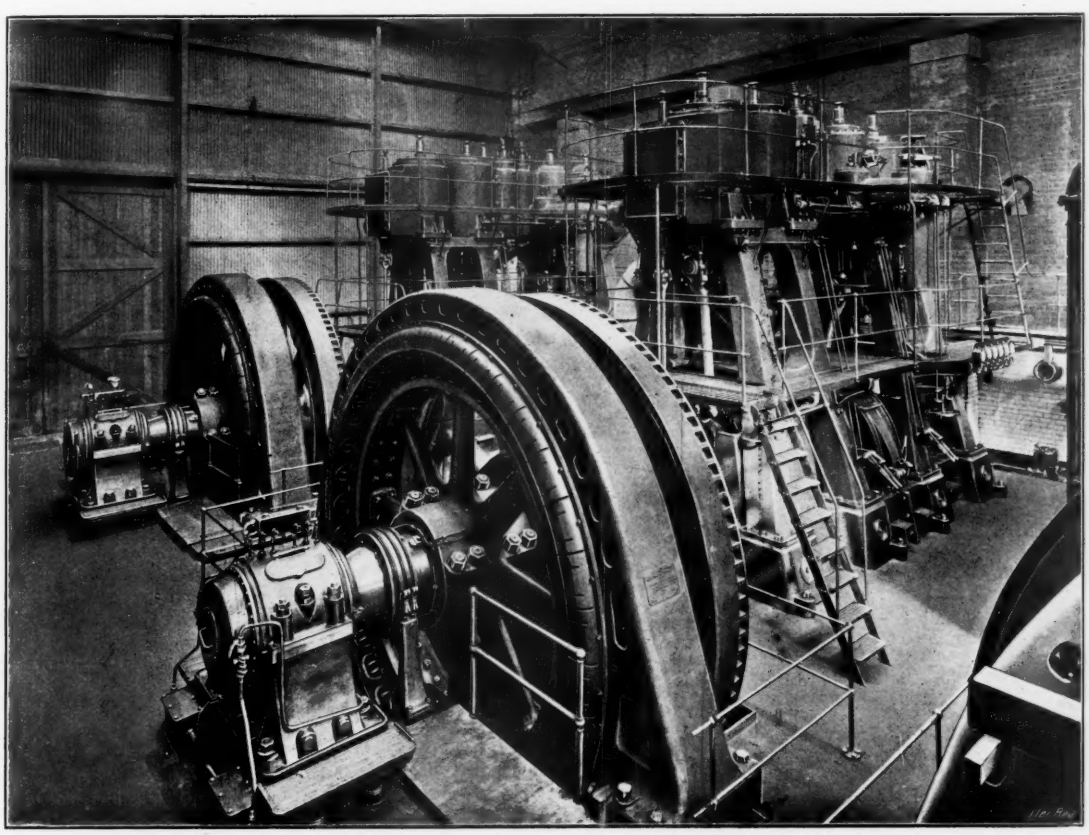
The field poles are built of punchings bolted together, these punchings being of high permeability, thus reducing the energy required for excitation, also hysteresis and eddy current loss due to fluctuations in the magnetic flux through the poles caused by the reaction of the armature current are almost entirely eliminated. The poles are firmly secured to a cast steel ring supported by a cast steel spider mounted on the shaft. The field winding consists of copper strip wound on edge, the successive turns being carefully insulated from one another and from the core. The normal exciting voltage is 240. Carbon brushes are used for the collector rings. The commercial efficiency of the generators is not less than 95 per cent. at full load and 91½ per cent. at half load, excluding the excitation, and the generators will carry an overload of 25 per cent. for half an hour without injury.

The rise in voltage upon throwing off full non-inductive load does not exceed 7½ per cent., and the temperature rise after a ten hours' run at full load does not exceed 40° C. as measured by the thermometer.

Direct Current Generators.—Each set consists of two 100-KW. generators supplied by the British Thomson-Houston Company, Limited, connected up tandem wise to a Belliss engine, the arrangement being such that the armatures are interchangeable. Each generator has an output as a shunt machine of 100 KW. at all voltages from 260 to 270 at a speed of 380 revolutions per minute, and as compound machines they give 250 volts at no load and 262 volts at full load. The armature cores are of the slotted type, with special ventilating ducts to ensure low temperature rise. The armatures are drum wound, the windings consisting of interchangeable copper coils set into slots in the periphery of the core and insulated therefrom with layers of specially prepared paper and linen. The commutators consist of segments of hard drawn copper insulated from each other by mica strips, and mounted on a cast-iron shell. The brushes are of carbon, provided with a flexible copper conductor connecting them to the brush-holders, thus entirely avoiding all sliding contacts between brush and holder. The field magnets are circular in form, with six inwardly projecting poles of mild steel, and are divided into two parts horizontally. The magnet coils are wound on separate formers, so that they can be readily slipped on or off. The bearings are of the self-aligning, self-oiling type, provided with oil rings. After a 24-hours' run at full load, the surface temperature of any part of the armature or field windings does not exceed 45° C. above that of the surrounding air.

Motor-Generator. — This set was supplied by Messrs. Richardsons, Westgarth & Co., and is designed for use in both directions, that is to say, either for receiving alternating three-phase currents and delivering direct current, or *vice versâ*. The set consists of one three-phase synchronous motor, wound for the full pressure of 5,500 volts, direct coupled to two continuous-current machines, each machine having an output as a shunt machine of 75 KW. when running as a generator at 400 revolutions per minute. Each machine is shunt and compound-wound, and gives at full load 240 to 270 volts. The combined commercial efficiency of this set at full load and normal voltage and running either way is not less than 85 per cent. The temperature rise after 10 hours' run at full load does not exceed 72° F. above that of the surrounding air as measured by thermometer.

High Pressure Switchboard.—The high pressure switchboard was supplied by Messrs. Ferranti, Limited; it consists of 17 panels, viz., six generator panels, one motor-generator panel, two meter panels, and eight feeder panels, and is suitable for working at 5,500 volts, three-phase. Each panel contains three fuses, three switches and three ammeters, and provision is made for disconnecting any



B.T.H. 700 KW. THREE-PHASE ALTERNATORS, DRIVEN BY WIGHAM, RICHARDSON & CO.'S ENGINES.

panel from the bus bar when alive by means of insulated tools. Bus bar voltmeter and synchronising gear in duplicate is provided at the top of the board.

The two watthour-meters are required for measuring the respective outputs of the two companies.

Low Pressure Switchboards.—The low pressure switchgear consists of three boards, two being on the floor level, and one being in the switchboard gallery. These panels deal with the two 200-KW. Belliss sets, the small exciter set, and the 150-KW. motor generator. One of the boards on the floor level holds the main dynamo fuses, the compounding switches, and the field switches. The main low pressure board is on the gallery and contains three sets of bus bars, viz. :—station power and lighting bus bars, exciting bus bars, and feeder bus bars. The station bus bars and exciting bus bars are arranged one on each side of the system, so that the station power and lighting circuits and the alternator exciting circuits are each operated quite independently at 250 volts. In this way the exciting circuits are kept entirely distinct from anything else, thus greatly reducing the liability of any mishap to the excitation. Double throw switches are provided by which any generating set can be thrown on to these bus bars or on to the feeder bus bars. The feeder bus bars are connected through a watthour-meter panel to the feeder board, which is arranged for four sets of three-wire feeders, and also includes a traction panel for the supply of power to the shunting loco. in the yard outside.

Test Pond.—A test pond has been constructed outside the station for the testing of the various generators. The arrangement consists of three plates of lead immersed in a brick pit filled with water. Each plate is separately suspended from a rope, passing over a pole carried on a wooden staging above the pit.

Three windlasses are provided at a safe distance from the pit by means of which each plate can be raised and lowered independently, and thus the load can be readily balanced and adjusted. Overhead wires connect these plates with terminals fixed on the wall of the switchboard gallery, from which temporary connections are made for testing any of the three-phase or continuous current generators, the pond being of sufficient capacity to absorb 1,500 KW. at 5,500 volts for any length of time.

Auxiliary Motors.—The following auxiliary motors of Bruce Peebles & Co.'s make are provided in the station : —Five centrifugal pump motors, each 20 H.P., at 800 revolutions ; four barring gear motors, each 6 H.P., at 1,000 revolutions ; one air compressor motor, 2 H.P., at 200 revolutions ; one vacuum pump motor, ½ H.P., at 600 revolutions ; one stoker motor, 15 H.P., at 900 revolutions ; one economiser motor, 2 H.P., at 700 revolutions ; one ash hoist motor, 6 H.P., at 600 revolutions ; one river pump motor, 15 H.P., at 350 to 700 revolutions ; one air pump motor, 40 H.P., at 100 revolutions.

(To be continued.)

Tyneside.—Ferranti High Pressure Three-phase Switchboard.

THE INSTITUTION OF ELECTRICAL ENGINEERS IN GERMANY.

I.

The immense variety and scope of the things seen and heard by the electrical engineers during the tour which came to an end last week, form the most eloquent testimony to the indefatigable efforts of our German hosts to instruct and entertain their guests ; on the other hand, they render it almost impossible for us to convey an adequate impression of them to our readers. We shall endeavour, therefore, to select from the mass of information before us such facts and figures as appear to be of special interest, dealing with them approximately in the order in which they were met with.

The programme drawn up for our guidance was tightly packed, but little time being left for private enterprise. Our first visit was set down for 5 p.m. on Sunday—half-an-hour after our arrival in Hanover ! The visitors were received by members of the engineering staff, and conveyed by electric tramcars to the works of

Messrs Körting Bros., Hanover.

[*Historical Note.*—The firm of Gebr. Körting, Hanover, was founded on November 1st, 1871, and the manufacture was restricted for the first few years to steam jet apparatus, such as undergrate blowers, injectors, &c.

In 1875 the first branch office was opened, under the name of Körting Bros., at Manchester, and shortly after works were established in Philadelphia, U.S.A., under the name of L. Schutte & Co. The latter business is now carried on quite independently.

In 1876 Mr. Körting constructed his now well-known compound or double-nozzle injector, which has since been introduced all over the world, and of which more than 130,000 have been made.

In the same year branch offices were established in Paris and Vienna, and later in Barcelona, Milan, St. Petersburg, and in nearly all civilised countries.

In 1876 Messrs. Körting commenced the manufacture of their now well-known gilled pipes for heating purposes ; this branch of the business has since been developed to an enormous extent, and now forms probably the largest of the departments of the firm.

At about the same time Messrs. Körting commenced the manufacture of gas engines on a small scale. The first engines were vertical engines, up to about 12 H.P. Messrs. Körting were very soon attacked for infringement of Dr. Otto's patents, and for many years the question was fought out in the German law courts until, on January 30th, 1886, the case was decided in Messrs. Körting's favour by the Reichsgericht, in Leipzig, the highest German court. Since then special attention has been paid to the development of gas engines. The business now has four departments:—(1) Jet apparatus; (2) heating and ventilation; (3) gas engines; (4) electricity; this last branch was taken up in 1893.

Messrs. Körting have since established works in Vienna, Genoa and Moscow; the total number of their technical and office staff has increased to about 300, and there are more than 3,000 workmen, of whom 2,000 are employed at the Hanover works.]

Of Messrs. Körting's specialities, the heating pipes and all kinds of gilled and plain radiators were seen in the foundry and stores. Their injectors and ejector condensers are so well-known that they hardly need be mentioned, but Messrs. Körting's gas engines and electrical manufactures are little known in England, and deserve some special notice. From the very beginning Messrs. Körting discarded the slide valve, which was generally used in the construction of all gas engines, and substituted special mixing valves which admitted gas and air always in the same proportion. They also introduced special igniters. The old method of governing gas engines soon proved insufficient. 300 H.P., and four-cylinder engines 600 H.P. These are the largest engines on the four-cycle system which the firm has built. One of them is shown in the foreground of our illustration of the works. The economy and thermal efficiency of these four-cycle engines exceed those of the best steam engines, as will be seen from the following figures. Small engines are, of course, less efficient than large ones.

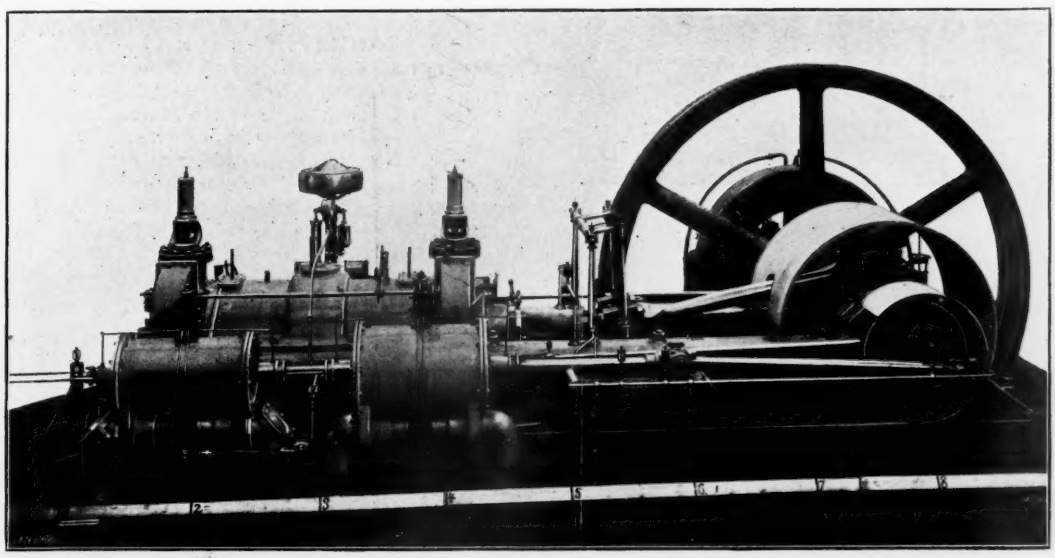
	Consumption of gas per H.P.-hour.	Thermal efficiency.
10-H.P. engines	500 litres	25·2 per cent.
25-H.P. „	450 „	28·4 „
50-H.P. „ (and above)	400 „	31·5 „

The above are the figures of efficiency in the engine, not counting losses in the manufacture of gas.

With producer gas the results are as follows :—

	Engines only.	Counting all losses in making the gas.
10-H.P. engines	22 per cent.	13·3 per cent.
25-H.P. „	24·2 „	15·3 „
50-H.P. „	28·5 „	19·9 „

These figures show that there is an enormous field for gas engines if only large engines can be produced at a reasonable cost, and this consideration induced Messrs. Körting to build an experimental engine on the two-cycle system, which engine was running in the large engine hall at the time of our visit, using producer gas. The engine has a



Single Cylinder Two-Cycle 400 H.P. Gas Engine.

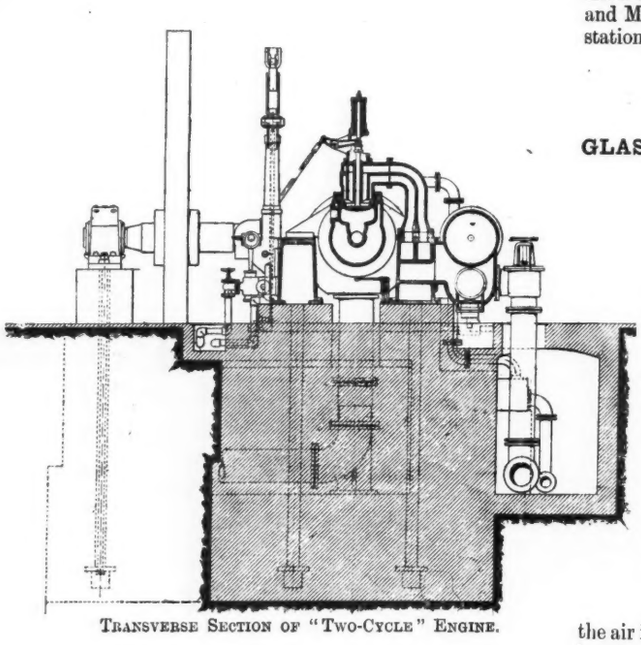
This method consisted in leaving out explosions altogether when the engines were increasing in speed above the normal rate. Messrs. Körting introduced several new methods of governing their engines by regulating the energy of the explosion, and all their engines, as built at present, make explosions after every compression, but reduce the energy of the explosion by admitting varying volumes of explosive mixture. In this way great regularity is obtained, and this was absolutely necessary as soon as Messrs. Körting introduced their gas dynamos, *i.e.*, gas engines coupled direct to dynamos. The introduction of these gas dynamos practically led to the manufacture of dynamos and electrical plant. A large number of small central stations in Germany are working with Körting's gas dynamos. Corporations who owned their own gasworks were glad to utilise gas as a motive power, and a large number of Körting's gas engines are used for pumping towns' water and for sewage works. The regularity of these engines is such that incandescent lamps can be worked direct from the gas dynamos without accumulators, and without flickering in the light.

With the introduction of this kind of work the sizes of engines had gradually to be increased. There was a time when a 60-H.P. gas engine was considered a large one, but when electricity was to be generated larger sizes were required, and the firm had to increase the power of their engines. Of the four-cycle type, gradually engines up to 150 B.H.P. were built. Twin sets of these gave cylinder 550 mm. in diameter and a stroke of 960 mm., and runs at 100 revolutions per minute.

The engine is of the double-acting type, with cylinder closed at both ends, the piston rod passing through a stuffing box; it is necessary, therefore, to artificially cool the piston and rod, for which purpose a cold water circulation is provided. The exhaust ports are in the middle of the cylinder, and are uncovered by the piston itself at the end of each stroke. The mixture of gas and air is admitted at either end by a lift valve driven from the crank shaft; separate double-acting pumps are provided for compressing the gas and air. The most interesting feature of the engine is the working cycle, in which the "scavenger" principle is utilised. At the end of the outward stroke after an explosion, the exhaust ports are opened and the burnt gases discharged; the admission valve then opens and admits a charge of air, which drives out the residual products of combustion. The exhaust ports are now closed by the piston on the inward stroke, and gas is admitted together with air; the admission valve closes, allowing compression to take place, and the gases are fired by electrical ignition devices, duplicated at both ends of the cylinder. To insure thorough mixture of the gases, and to prevent waste and premature ignition, the entering charge is caused to strike against a special baffle plate below the admission valve, which imparts a whirling motion to the gases. Governing is effected by varying the amount of gas admitted to the cylinder.

The results obtained with a 350-H.P. engine of this type by Prof. Meyer last year are as follows :—

Working with producer gas, the engine gave at full load 536 I.H.P., the pumps absorbed 62 H.P., and the B.H.P., as



Transverse Section of "Two-Cycle" Engine.

measured by an electric brake, was 337 H.P., giving a mechanical efficiency of 71 per cent. The gas consumed (of calorific value 129 B.Th.U. per cb. ft.) was 58 cb. ft. per I.H.P.-hour, after deducting the power used by the pumps, and 81·5 cb. ft. per B.H.P.-hour. The corresponding thermal efficiencies were 33·5 and 23·8 per cent. These high values would have been impossible if any sensible loss of gas occurred in the exhaust.

The fly-wheel of the engine only weighs 8 tons, and the total weight does not exceed the weight of a steam engine with condenser of the same power.

A four-cycle engine of the same power would have to have a cylinder 1,100 mm. in diameter.

The results have proved satisfactory to such an extent that Messrs. Körting are now building larger engines of this type, and will shortly have ready a 500-B.H.P. engine. They are further constructing several twin engines to give 1,000 B.H.P., which will be coupled direct to alternators. All these large engines are intended to be worked with blast furnace gases, and if the engines now in course of construction prove thoroughly reliable and efficient, there seems to be no reason why even larger engines should not be constructed on the same principle.

Messrs. Körting's electrical department is established in a separate works, in close proximity to their large works at Körtingsdorf. They are building all kinds of dynamos and motors for continuous, alternating and three-phase current, and Messrs. Körting have equipped many lighting and power stations in Germany, Italy, Austria and other countries.

GLASGOW INTERNATIONAL EXHIBITION. 1901.

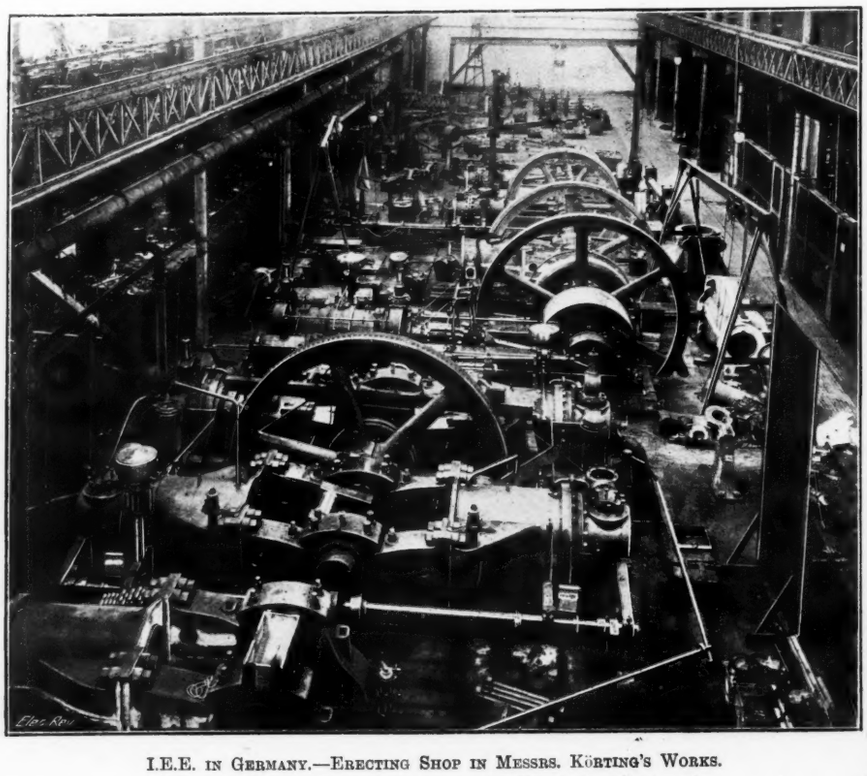
III.

In view of the enormous importance to which the subject of gas production and utilisation is rapidly attaining, the following description of the producer plant, installed in connection with the Stirling boiler, referred to in our last issue, will be not without interest.

The producer, of which we give a photographic view, as well as cross-sections in two planes, was made by Messrs. W. F. Mason, Limited, of Longsight, Manchester, under the Duff patents, and stands just outside the end of the boiler house.

It is 12 ft. diameter × 11 ft. 6 in. high, and is capable of gasifying about 15 cwt. of coal per hour. The grate is formed of perforated cast-iron grids, set at an angle of 45°, through which the air is forced by a steam jet blower.

The advantage of this grate over other types is that the air is evenly distributed through the whole mass of the fuel, keeping an even temperature in the producer, and preventing the fire burning through in holes; the formation of the large masses of clinker which accumulate where a large volume of air is directed against one particular part of the fire is also avoided.



I.E.E. in Germany.—Erecting Shop in Messrs. Körting's Works.
(Four-cylinder "Four-cycle" 600-H.P. Gas Engine in foreground.)

The producer is continuous in working; the ash falls from the inclined grates into the water trough, and is raked out from either end. The air is prevented from escaping by two steel girders across the trough which dip into the water, and

on which the brick lining of the producer is built. (The trough is not shown in the photograph.)

There are two large coal-charging hoppers on the top of the producer, with poking holes situated round them for stirring the fuel.

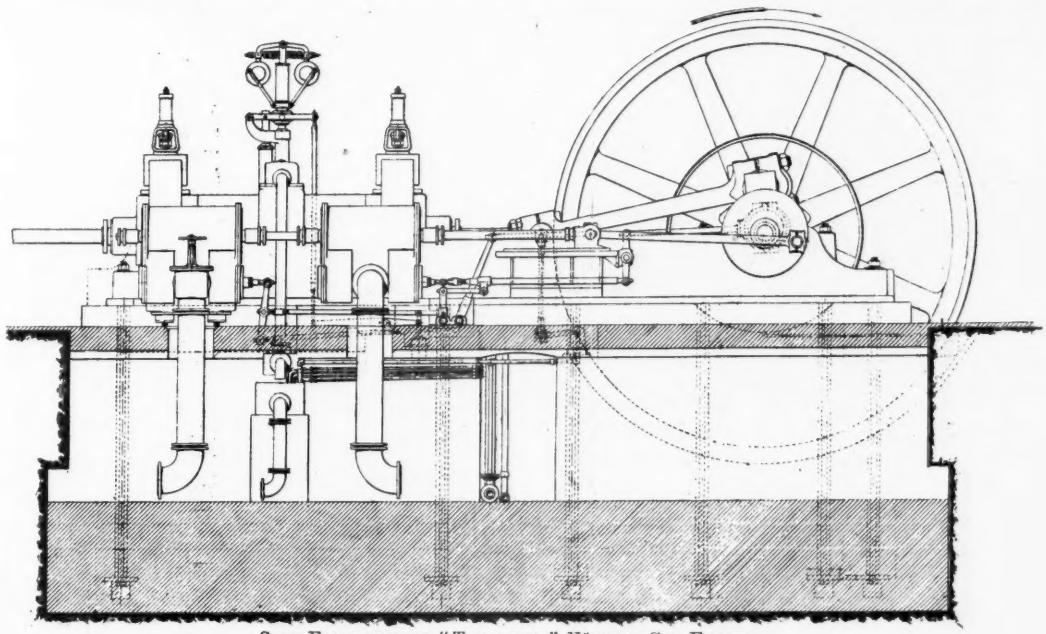
The producer is used for supplying gas to fire a water-tube boiler; the economy in firing with gas is due to the possibility of burning a far cheaper class of coal in the producer than can be used with a hand-fired grate.

There is also the advantage that the life of the boiler is increased, as an even temperature can be maintained by the gas in the combustion chamber of the boiler; there is no need to open the doors periodically, so that the strains which the tubes in a water-tube boiler and the flues in a Lancashire boiler are constantly subjected to, when the firing doors are opened and a large volume of cold air is drawn in over the fuel, are not incurred.

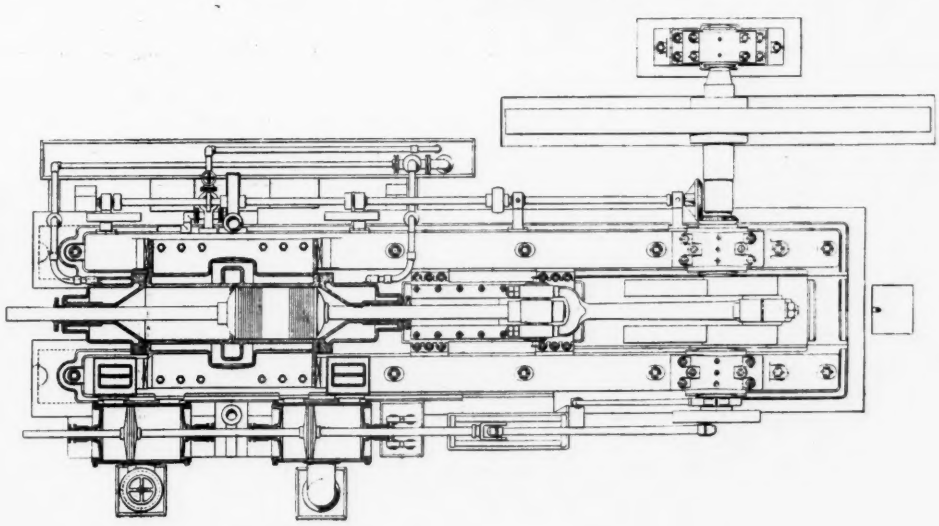
Next in order to the Stirling boilers comes the exhibit of Messrs. Davey, Paxman & Co., who are showing a complete installation of boiler, superheater, economiser, and engine driving a dynamo. The intention is to carry out complete tests of the whole plant, from coal and water to, electricity, and the arrangements have been made expressly with that purpose.

The boiler is of the well-known standard "Economic" type, 8 ft. 9½ in. diameter and 14 ft. 6 in. long, with two main flues, each 3 ft. in diameter, fitted with the firm's patent expansion joints. The shell is intended for a working pressure of 160 lbs. per square inch, and is double rivetted throughout, with treble-rivetted butt straps. There are two Galloway tubes in each flue, and 100 return tubes, each 3 in. in diameter inside; 16 of these are stay tubes. A special feature, peculiar to the "Economic" boiler, is the manner in which the return tubes are splayed at the fore end so as to permit of ready access to the interior between them. The grate is 6 ft. 6 in. long and has a total area of 32 square feet; the normal output is 8,000 lbs. of dry steam per hour, without forcing.

The superheater is erected by the side of the boiler. and is separately fired; it consists of seven sections of horizontal **U** tubes, over a firing chamber 4 ft. long × 2 ft. 3 in. wide. The saturated steam from the boiler passes first through the lowest section, nearest to the fire; it is then led up to the uppermost section, and passes downwards step by step to the second section, from which it is led away to the steam range. The working temperature at the engine is 650° F., corresponding to about 280° superheat. The economiser is so arranged that, while all the parts are



Side Elevation of "Two cycle" Körting Gas Engine.



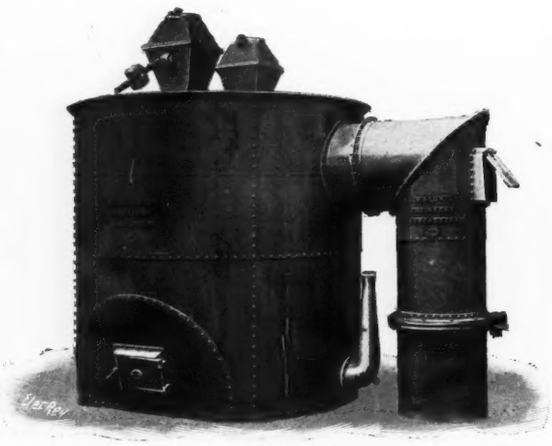
I.E.E. in Germany.—Part Sectional Plan of "Two-cycle" Körting Gas Engine.

tion prove thoroughly reliable and efficient, there seems to be

steel girders across the trough which dip into the water, and

standard, various combinations can readily be made to give greater or less superheat, with corresponding changes in the rate of delivery of steam.

The economiser, which is of Messrs. Green's usual type, having 120 tubes, with 1,200 sq. ft. heating surface, is



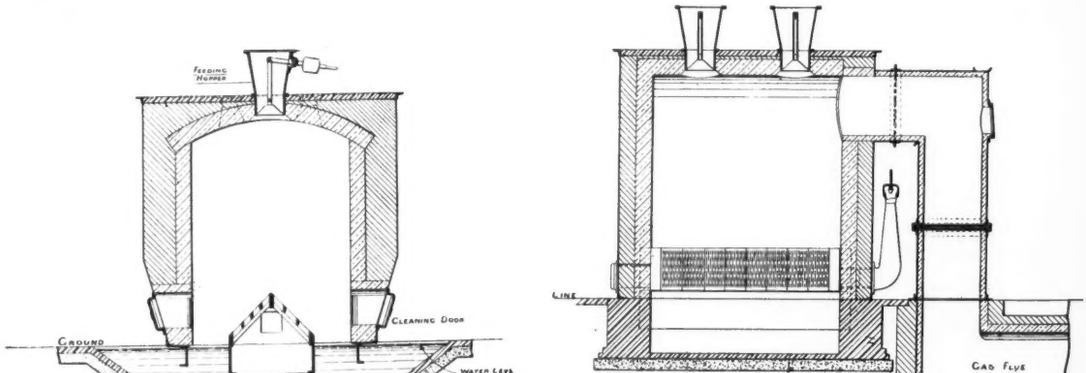
The water trough is omitted from this view.

Mason Gas Producer.

intended more for the gases from the superheater than for the boiler flue gases, which are sufficiently cooled without it.

The equipment of Messrs. Davey, Paxman's exhibit in the boiler house is completed by a Weir feed-water pump, feed-water measuring tanks, and a feed-water heater having a heating surface of 200 sq. ft., which receives the exhaust steam from the main engine. The latter will be described later on.

Messrs. Penman & Co. exhibit four Lancashire boilers of their usual type, each 30 ft. long by 8 ft. diameter, with two flues 3 ft. 3 in. diameter; the flues taper to 2 ft. 9 in. diameter at the ring next to the last one, which is parallel,



Cross-sections of Mason's Gas Producer.

and are constructed on the anti-collapse flanged seam principle, by which all rivet heads, double thicknesses, and edges of plates are removed from the action of the hot gases.

The boilers are made of selected Siemens-Martin mild steel plates throughout. Each ring of the shell consists of a single plate; the longitudinal seams are butt strapped inside and out, and are rivetted together by means of four rows of rivets, and the circular seams are lap-jointed and double rivetted. The boilers are equipped with mountings of the highest class, and are intended for a normal working pressure of 120 lbs. per square inch. The grate bars are arranged so as to be rocked sideways by hand when it is necessary to break up the clinker—an operation which is very easily and efficiently done by this device.

Dielectric Losses in Condensers.—In the *Electrical World and Engineer* for June 22nd, Mr. C. P. Steinmetz gives the results of some determinations of the loss of power in electrostatic condensers on an alternating current circuit which he has made upon a number of condensers at various frequencies and voltages, and as the subject of capacity in alternating current working has recently been very much in evidence, his conclusions will be very interesting to many of our readers. He finds that: (1) With a sine wave of impressed E.M.F. the current in the condenser is directly proportional to the impressed E.M.F. and to the frequency; that is, the capacity of the condenser on an alternating current circuit is constant. (2) The loss of power in the condenser is, within the range of tests, proportional to the square of the impressed E.M.F.; that is, the power factor of the condenser, at constant frequency, is constant and independent of the impressed voltage. (3) The power factor of the condenser does not seem to vary with the frequency; that is, the efficiency of the condenser appears to be independent of the frequency; or, in other words, the loss of energy per cycle is proportional to the square of the electrostatic field strength, but independent of the frequency, as far as can be seen. (4) The power factor of well-made condensers is extremely low, averaging about ·005, or the efficiency is about 99·5. The actual efficiencies he obtained varied between 99·625 per cent. and 99·325 per cent., so that the condenser is one of the most efficient pieces of apparatus known. As regard the existence of a true dielectric hysteresis, he believes such a phenomenon exists, but is under the impression that at least a very large part of the observed loss is not due to hysteresis, but is due to traces of air which are still occluded in the dielectric of the condenser, and is caused by mechanical motion of the air molecules under the influence of the alternating electrostatic stress.

The Talking Searchlight.—Dr. Simon has described before the German *Elektrotechnischer Verein* some experiments he has made with his interesting apparatus (already noticed in the Electrical Review) for transmitting speech through the beam of a searchlight. In his experimental apparatus an Aron arc lamp (with mercury electrodes *in vacuo*) was impressed with speech vibrations in the well-known way adopted by Simon, Duddell, and others. The light rays from this lamp were converted by lenses into a parallel beam which at some distance was converged by another lens upon a very sensitive selenium cell. The selenium cell was in series with a battery and a choking coil, and the receiving telephone with a condenser was connected in shunt with the selenium cell. Speech impressed on the arc was distinctly heard in the telephone connected to the selenium cell. The distance over which the speech was transmitted is not given, and probably was only a few feet. The experiment, however, shows that this novel method of wireless telephony is practicable.

purpose.

economiser is so arranged that, while all the parts are

ELECTRIC TRACTION NOTES.

(*Continued from page 58.*)

Darlington.—The T.C. has decided to purchase the present tramways from the Imperial Tramways Company, together with a prov. order for the construction and working of electric tramways, also to spend £12,000 on the extension of electric lighting plant to provide sufficient energy for working 20 to 30 tramcars.

Dysart.—The T.C. has appointed a committee to confer with Kirkcaldy T.C. with a view to the extension of the Kirkcaldy tramway scheme so as to include Dysart.

Glasgow.—A draft copy of the balance-sheet for the past year has been submitted by the Tramways Sub-committee. The year ends with May 31st last. The result of last year's working when compared with the previous year's operations is as follows:—

	1900—1.	1899—1900.
Revenue	£489,469 8 7	£466,965 10 11
Working expenses	371,705 7 1	344,721 11 3
Gross balance	£117,764 1 6	£125,243 19 8

This gross balance has been expended as follows:—

Rent of Govan and Ibrox tramways	£5,057 14 7
Interest on capital	38,979 0 0
Sinking fund	19,470 13 4
Depreciation written off capital	29,758 16 7
Payment to common good	12,500 0 0
	£105,766 4 6
Transferred to general reserve fund	11,997 17 0
	£117,764 1 6

The decrease in gross balance is £7,479 18s. 2d., although there is a big increase in the revenue; it is accounted for by the fact that horse provender rose considerably throughout the year, and by the increase in local and Imperial taxes. The net balance shows a decrease of £34,570 15s., as compared with last year, due largely to increased interest and sinking fund charges on account of change from horse to electric haulage.

	Horse.	Electric.
Traffic receipts	£404,614 13 3	£80,358 4 7
Other receipts	4,462 10 1	134 0 8
Working expenses	335,992 2 8	86,423 4 5
Percentage of expenses to receipts..	82 %	46 %
	June 1st, 1900.	June 1st, 1901.
Capital account	937,033 5 9	£1,793,934 8 1

Depreciation written off capital since 1894 amounts to £153,796 11s. 8d. The total amount borrowed for capital purposes is now £1,680,732 0s. 1d., of which £846,000 has been borrowed this year. The total capital expenditure this year amounts to £886,659 18s. 11d., and it was mainly spent in connection with the conversion of the system from horse to electric traction.

The threatened strike of drivers and conductors on the Corporation system did not occur on Saturday last, as a sub-committee had announced the Corporation's intention of resuming the older system of a nine-hour day, and 30s. a week for men with three years' service, and also possessing a certificate as motor-man. The men were still discontented, and re-drafted their petition requesting a direct answer by the 10th inst.

The electric cars were on 1st inst. placed on the Mount Florida route, so that the whole of the horse cars on the route between Mount Florida and Maryhill are now withdrawn.

Isle of Man.—The Clerk of the Rolls has approved of a scheme submitted by Mr. W. H. Walker, liquidator of the Isle of Man Tramways and Electric Power Company, Limited, for the sale of the properties of the company by tender. The properties are now being offered in three lots, Lot 1 comprising the Douglas and Laxey, the Laxey and Ramsey, and the Snaefell mountain electric tramways and the houses, &c., connected therewith. Lot 2 comprises the Douglas Bay horse tramway and the Upper Douglas Cable Tramway, with the horses, sheds, &c. Lot 3 consists of Lots 1 and 2 combined.

Kidderminster.—The Kidderminster—Bewdley light railway order is to be confirmed by the Board of Trade, with certain amendments which were agreed to before Mr. Hopwood, on Tuesday.

London.—The Highways Committee reported at a meeting of the London County Council on Tuesday that the preparation of the specifications and plans in connection with the conversion of the three South London tramways first to be put in hand was being proceeded with as rapidly as possible. The work of reconstructing the tramways would occupy considerably less time than the erection of the generating station, and it had occurred to the Committee that pending the building of the station the transformation of the tramways should be pressed on with the utmost despatch, and temporary arrangements made for obtaining a supply of energy for working the cars. It had been ascertained that the South London Electric Supply Corporation, whose generating station is near the Loughborough Junction Station of the South-Eastern and Chatham Railways, would be willing for the Council to erect a temporary building on the company's land there, and to place therein two 2,500-H.P. continuous current sets of electric generating plant and auxiliaries, and also to place temporarily in the company's boiler house two of the Stirling boilers for the supply of which the Council has already entered into a contract. Both the generating plant and the boilers would be removed to the main generating station to be erected by the Council for the purpose of the electrical working of the whole of its tramways south of the Thames. If this arrangement were entered into, it was estimated that the cost to the Council, over and above the prime cost of the engines, boilers, &c., would be about £10,000, but this would be more than met by the profit from the electrical working of the tramways being accelerated. The company was willing that the generating plant referred to should be worked by a staff in the employ of the Council, and the company supplying steam-power and being paid at the rate of 1·4d. per unit of current generated. It was estimated that the cost of working the lines under this temporary arrangement would be ½d. per mile more than if the Council were in a position to commence the working of the tramways from its own generating station as soon as they have been reconstructed; but, even taking this into account, the extra profits arising from the substitution of electrical power for horse-power on the first three lines would probably be £25,000 a year. It therefore appeared that the arrangement suggested above would be of distinct advantage to the Council. The report proposed that, should it be found advisable, the above-mentioned arrangement should be made to apply to the reconstruction for electric traction of the tramways between the Elephant and Castle and Greenwich, and to the transformation of other and shorter lines. It was hoped very shortly to settle the forms of specifications and contracts for these works in order that tenders might be received early in October. The Committee, therefore, recommended the Council to enter into an agreement with the company in accordance with the terms of the above report. After a brief discussion, the recommendation was adopted.

Manchester.—The tramway deadlock between the authorities of Manchester and Salford continues. The matter was discussed by both Councils at their respective meetings on Wednesday last week. The Manchester Tramways Committee expressed themselves as perfectly prepared to reopen negotiations, given the principles that neither Corporation should make a profit within the boundary of the other, and that they should have an adequate service on the lines to be worked by Salford within the city. At the Salford meeting a resolution was carried also with a view to an equitable and amicable settlement of the terms.

The Corporation last week commenced to run electric cars along Rochdale Road. The ½d. service to the Grove Inn, on the Bury New Road, has been a great success.

Mitcham.—The U.D.C. has been granted a light railway order, subject to approval of the draft which is being examined by a committee.

Oldham.—The Tramways Committee recently notified the Bury, Rochdale and Oldham Steam Tramway Company that their services would not be required beyond October next. This was in answer to the company's inquiry as the whether the Corporation would require the lines to be worked by the company beyond the expiration of the lease. The question of a charge of 2d. per unit proposed to be made by the Electricity Committee for the supply of energy for traction which was thought to be excessive was discussed, and it was decided to ask for a reconsideration of the charge. An inspection has been made of a design of combination car (*i.e.*, open at each end and the middle portion enclosed), and also consideration has been given by the Committee to the question of additional motor equipment for the cars now in use and on order. It was decided on the advice of the electrical adviser to fit the 12 cars on order with Dick, Kerr & Co., Limited, with double bogies of equal sized wheels, and each axle to be motor driven, at certain additional cost mentioned. The question relating to the combination cars was deferred. The tender of Dick, Kerr & Co. for the supply of tramway rails and fish and sole plates was accepted. The borough surveyor has been instructed to prepare a plan showing a tramway loop line at the corner of Glodwick Road and Lees Road, and to proceed with the equipment of the old tramway routes from Hollinwood to Waterhead, and from Hathershaw to Royton. The Crossbank Parish Council have asked the Committee to favourably consider a scheme for running electric trams in a circular route from the terminus at Leesbrook to that at Waterhead.

St. Helens.—The question of using pneumatic guards for the electric cars has been raised in the Council chamber, and the matter may be brought before the company.

Southend.—The municipal electric tramways have been inspected by B. of T. officials. It is expected that they will shortly be running.

Southport.—The first annual report of the working of the Southport electric tramways has been issued; 5 miles of single and 2½ miles of double track have been at work, and 208,756 car miles have been run. 1,513,354 passengers have been carried. The receipts have been £7,568 17s. 7d., and the expenditure, including interest, £7,487 12s. 1d., leaves a profit balance of £81 5s. 6d.

Stourbridge.—The British Electric Traction Company Company have completed their line from Lower High Street, Stourbridge, to a point in the Hagley Road, and on 4th inst. it underwent inspection by Colonel Yorke, R.E., of the Board of Trade.

necessary to break up the clinker—an operation which is very easily and efficiently done by this device.

The experiment, however, [illegible] wireless telephony is practicable.

West Bromwich.—Arrangements have been completed for the purchase by the Corporation of the tramways; £5,500 is to be paid to the Birmingham and Midland Tramways Company, Limited, and £32,000 to the South Staffordshire Tramways Company for the lines belonging to these companies within the borough. A further sum, to be ascertained, is to be paid to the latter company as compensation for loss of rent under the terms of their lease to the lessee company.

West Riding.—Plans and report for two alternative schemes for an electric branch railway to Slorthes Hall Asylum have been drawn up by the surveyor to the West Riding County Council. The cost is placed at between £16,000 and £17,000. Further details are being drawn up before the scheme is proceeded with.

Wigan.—The negotiations between the E. L. and T. Committee and the District Tramways Company for the purchase of the tramway system have for the time been broken off. It is likely that they will shortly be resumed, and the Corporation acquire the property.

Woolwich.—The M.B.C. has consented to the proposal of the London County Council to construct a tramway from New Cross to Eltham, and has undertaken to pay one-third of the cost of street widenings in the borough, subject to the L.C.C. extending the tramway to the Herbert Hospital. The total cost of the widenings will be about £11,500.

The Light Railway Commissioners on Tuesday, 2nd inst., held an inquiry at William Street, Woolwich, in respect to the application of the Auxiliary and Light Railways and Tramways Company, Limited, for a line from Woolwich to Eltham, which application the M.B.C. opposed. Later information says that the scheme promoted by a company to construct an electric tramway between Woolwich and Eltham has not been proceeded with. It was opposed by the local authorities and the L.C.C.

Worthing.—The Council requires a lot of convincing that it is in the wrong in opposing all ideas of electric traction for Worthing. A Committee has gone so far as to recommend the Council that if trams are to be introduced they must be under municipal control. The discussion on this recommendation led to speechifying from men anxious to continue the slow-coach policy of no trams which will make Worthing rank far behind other seaside resorts in respect of public convenience. We trust that when the Council discusses the matter again shortly, its members will have set their prejudices aside, and will be prepared to take a forward step for the benefit of the town and of the many thousands of visitors with whom it is a place of holiday resort. A little inquiry in other towns should soon dispel the fallacy under which Councillors now labour.

TELEGRAPH AND TELEPHONE NOTES.

An Inventor's Tragedy.—A correspondent sends us the following:—"An endeavour is being made in France to get a consideration of the case of the inventor Mimault by the Postal Telegraph authorities. At the present moment this unfortunate man is earning a precarious livelihood as street sweeper in Cayenne. The story of his life is one of the saddest of the many sad histories that are associated with great inventions. In 1886 Mimault entered the service of the Postal Telegraph Department, and worked in daily contact with young Baudot, the successful inventor of the marvellous Baudot telegraph apparatus. Mimault was a most intelligent and enthusiastic worker, and soon made very considerable progress in the technical side of his profession. After a long series of experiments carried out at his own expense, he succeeded in producing an apparatus for the simultaneous multiple transmission of telegrams by using only one wire. He patented his invention, and endeavoured unsuccessfully to induce the administration to adopt it. Shortly after this Baudot produce a multiplex telegraph apparatus founded upon the same principles as those of Mimault's invention, and Baudot's invention was taken up by the Postal Administration. Mimault immediately accused Baudot of the theft of his idea, which, he said, he had confided to him. An action at law was taken and was successful, but on appeal the decision was reversed. Mimault wished to carry his case to the *Cour de Cassation*, but was persuaded by the Administration to forego the intention. In 1887 he applied for a further sum of money from the Department, but was refused. He associated this refusal in some way with the Director of the Superior School, M. Reynaud, and one day he lay in wait with a revolver, and as M. Reynaud left the school, shot at him and wounded him mortally. For this mad act he was condemned to 10 years' penal servitude and 20 years' expatriation. He has now finished the penal servitude, and is working as above described at Cayenne. The movement we have referred to has for its object to obtain his pardon, so that he may return to his native land."

Brussels Telephones.—The placing of the wires of the Brussels telephone system underground has been an undertaking of much difficulty. The administration of the telegraphs department who had charge of the undertaking had in reality to construct an entirely new system. The conductors, protected by lead piping, are placed in conduits, and the entire work has cost for a system of 32 kilometres a sum of about 1,350,000 fr.—500,000 fr. for the conductors and 850,000 fr. for the conduits. The new exchange is situated in the centre of the city, and connects its subscribers by means of 92 cables, each capable of serving 200 subscribers. With commendable foresight the administration has provided for the exigencies of the service for the next 20 years. The exchange as at present installed can only serve 13,000 subscribers, but there will be no difficulty in installing new switchboards as they may be required. The Belgian Government in placing the wires underground had two objects in view—the removal of the different causes which in the overhead system deprive subscribers from time to time of the use of their apparatus, and which entail on the part of the administration heavy expenditure for repairs. The effects of induction will also be obviated, while the use of a double wire will be an appreciable improvement. It should be mentioned that it is only the wires of the metropolitan area that have been placed underground, the suburban wires being still overhead. Our correspondent states that it is hoped, in view of the economy resulting from the use of an underground system, that a reduction in the present subscription rates may be introduced at an early date.

Telegraphists Interview Lord Londonderry.—On July 9th, at 12.30 p.m., in his Deputation Room at the General Post Office, the Postmaster-General received a deputation of telegraphists for the purpose of discussing the alleged "breach of faith" with regard to the maximum of that class. Lord Londonderry was accompanied by Sir George Murray, and the deputation consisted of Messrs. R. H. Davis, S. W. Belderson, and C. H. Garland. In his opening remarks Lord Londonderry said he was not prepared to discuss the general question of wages, but a very serious allegation had been made against his predecessors with regard to this matter, and he felt compelled to clear it up. Mr. R. H. Davis opened the case for the men, and read a lengthy statement which recapitulated many of the arguments which have already been adduced in the columns of the Electrical Review, and criticised at some length the last communication of the Postmaster-General on the subject. Sir George Murray said that so long as the £190 class existed it could not be contended that there was no prospect of £190, and a lengthy discussion ensued on the interpretation of the words "prospect of attaining £190," in which Mr. S. W. Belderson took part. Mr. Garland said they did not wish it to be understood that they had a legal contract, but waiving the question of legality there remained the moral obligation to fulfil the regulations laid down on entry. In all other departments of the Civil Service the regulations were regarded as the charter of engagement, and any alterations made always carefully safeguarded the rights of existing holders. In the appointments of statutory officers by County Councils and local authorities, provision was always made that any alteration which was detrimental to the interests of those officers already employed was accompanied by compensation to them. He contended that "the prospect of £190," on the Postmaster-General's own showing, meant something which was at least "humanly possible," and he cited cases to prove that under existing conditions it was impossible to attain to £190 within the span of a human life. Sir Geo. Murray suggested that an epidemic among the senior clerks might open up a prospect, and Mr. Garland replied that he was prepared to admit the possibility under such circumstances, and if the "prospect" held out to him had said "subject to an epidemic occurring," he could treat the matter not as a serious "breach of faith" but as a huge joke. Passing on to the recommendation of the Tweedmouth Committee that £160 was sufficient pay for an operator, he said this recommendation must be interpreted in the light of the evidence upon which it was founded, and he cited Sir S. Walpole and Sir H. C. Fischer to the effect that such a maximum must be accompanied by a more liberal system of promotion. As a matter of fact the official figures proved that there had been an actual deterioration of prospect of promotion since the Tweedmouth Committee's report. After some further discussion the deputation withdrew, Lord Londonderry promising to communicate his decision at a later date.

Telegraphic Interruptions and Repairs :—

	Interrupted.	Repaired.
Cables.		
Latakia-Cyprus	June 20, 1899	
Para-Maranham	March 1, 1900	
Singaradya-Ampenan	July 3, 1901	
Basseterre-Les Saintes	June 29, 1901	
Landlines:—		
Cayenne-Pinheiro	April 20, 1901	
Pekin-Kalgan	June 14, 1900	
Maimatchin-Kalgan	June 30, 1900	
Bolama-Bissao	July 4, 1901	
San Domingo landlines	July 9, 1901	

The Telegraph Wire Export Trade.—The month of June proved to be one of the quietest so far this year as regards the export trade of this country in telegraph wire and apparatus connected therewith. The value of the shipments only amounted to £96,048 as compared with £245,333 in May last and £47,994 in June, 1900. Taking the six months ending with June, however, the year has been one of the most active on record. The value of the exports during that period is returned at no less than £1,719,360, as contrasted with £1,459,710 in the corresponding half of 1900, and only £501,673 in the first six months of 1899.

The Pacific Cable.—The Earl of Ranfurly, the Governor of New Zealand, in his speech at the opening of Parliament last week, said that the commencement of the construction of the Pacific cable was an accomplished fact; the contract had

temporary building on the company's land there, and to place

went inspection by Colonel Yorke, R.E., of the Board of Trade.

been signed, the Board of Advice had been formed, and the work of laying the cable was progressing. This Imperial work would be advantageous alike to the Colonies and the Mother Country.

Wireless Telegraphy.—The *Morning Post* Washington correspondent says that the U.S. Department of Agriculture will begin exhaustive experiments in wireless telegraphy this month under the direction of Prof. Fessenden, of the Department's staff of experts. "Prof. Fessenden has made some great improvements on the Marconi system, but his methods are kept a profound secret, because the Government cannot patent any discovery of its own. Wireless messages by the Fessenden system can be sent 50 miles over broken country and 150 miles over water. The crucial test of the system will be made off the Atlantic coast in the presence of naval officers."

While on her way towards Liverpool on Friday last the Cunard liner *Lucania* picked up broken signals from the Marconi station at Crookhaven, on the south-west coast of Ireland, at 2.10 p.m. At 2.25 p.m. they became coherent, and the first message was sent out from the ship at 2.30 p.m., the distance at this time being about 43 knots west of Browhead. Communication was maintained with Crookhaven until Roche's Point, at which a temporary station is being fitted, was picked up. Communication was next established with Rosslare, on the south-east cost of Ireland, when about 44 miles distant, and signals were exchanged with the operator until the station had been left behind 40 miles. Holyhead was picked up at a distance of 40 miles, and messages continued to be sent through that station until it was left behind 38 miles.

CONTRACTS OPEN AND CLOSED.

OPEN.

Amsterdam.—September 2nd. H.M. Consul at Amsterdam states that tenders are invited by the Municipality of Amsterdam for the supply of "electrical tram-carriages arranged for above-ground supply of electricity, and for about 5,000 tons of grooved rails for tramways, with necessary appurtenances." Particulars may be obtained from the Director of the Municipal Tramways, Nieuwe Achtergracht, No. 164, Amsterdam.

Aston Manor.—July 25th. The Council wants tenders for electrical plant (gas engines and dynamos, motor transformers, switchboard, battery, cables, wiring, &c.), for wiring a fever hospital and a small-pox hospital. See "Official Notices" to-day.

Birkenhead.—July 16th. The Corporation wants tenders for 15 electric car bodies, also equipments, trucks and trolleys. See "Official Notices" June 21st.

Blackburn.—July 29th. The T.C. wants tenders for three triple-expansion 775-kw. steam dynamos. See "Official Notices" to-day.

Bradford.—July 31st. The Corporation wants tenders for 100 electric cars. See "Official Notices" to-day.

Brecon.—August 5th. Tenders are invited for electrically lighting the Brecon and Radnor Joint Asylum now erecting at Talgarth. See "Official Notices" June 28th.

Cleckheaton.—July 13th. The Council wants tenders for Lancashire boilers, economiser, condenser, pumps, Meldrum's furnaces, balancers and boosters, battery, cables, switchboards and travelling crane. See "Official Notices" June 28th.

Darlington.—July 16th. "Free" or "assisted" wiring proposals are wanted by the E.L. Committee. See "Official Notices" June 21st.

Dartford.—July 24th. The Council wants tenders for D.C. meters and cut-outs. See "Official Notices" July 5th.

Dundee.—August 5th. The Gas Commissioners want tenders for condensing and cooling plant, electrically and steam driven pumps, feed heaters, &c., for the electricity works. See "Official Notices" to-day.

France.—July 18th. Tenders are being invited until the 18th inst. by the French Post and Telegraph authorities in Paris for the supply of 280 tons of copper wire. Tenders are to be sent to Le Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, Paris, whence particulars may be obtained.

Gravesend.—July 30th. The T.C. wants tenders for water tube boilers, piping, engines, dynamos, balancer, boosters, switchboard, mains, lamp posts, battery, meters, cranes, destructor, well and water lifting apparatus. See "Official Notices" to-day.

Greenock.—July 17th. The Police Board wants tenders for surface condenser, &c., and fan for induced draught. See "Official Notices" July 5th.

Hammersmith.—July 17th. The Council wants six 50-kw. transformers and a quantity of electricity meters. See "Official Notices" to-day.

Hapton (Lancs.).—July 31st. The Clerk to the Parish Council is inviting tenders for the electric lighting of the township from September next to the following April.

Holland.—September 2nd. The municipal authorities of Amsterdam are inviting tenders until September 2nd next for the supply of 5,000 tons of steel tram rails, with accessories, required for the municipal electric tramways. Particulars may be obtained from, and tenders are to be sent to, Le Directeur des Tramways Municipaux, Nieuwe Achtergracht, 164, Amsterdam.

Kearsley.—August 1st. The U.D.C. wants tenders for tramway poles, section boxes, overhead line, &c., for 1¾ miles of tramway. See "Official Notices" to-day.

Kirkcaldy.—July 20th. The Corporation wants tenders for feeders, mains, road work, and arc lamps. See "Official Notices" June 28th.

Lancaster.—July 22nd. The Corporation wants tenders for water tank, electric pumps, condenser, piping, &c., for the electricity works. See "Official Notices" to-day.

London.—July 23rd. The L.C.C. wants tenders for boilers, pumps, cooking apparatus, and electric lighting installation (exclusive of generating plant) for Horton Asylum. See "Official Notices" July 5th.

Manchester.—August 14th. The Electricity Committee wants tenders for H.T. switchboards, exciter and auxiliary switchboards for the Stuart Street generating station, also high and low tension boards for sub-stations. See our "Official Notices" to-day.

Mansfield.—July 12th. The Corporation wants tenders for Lancashire boilers, stokers, pumps, economiser, 200-kw. steam generators, motor transformers, condensing plant, switchboard, battery, crane, mains, arc lighting, meters, and workshop equipment. See "Official Notices" June 7th.

Pontypridd.—July 23rd. The Guardians want tenders for electric lighting at the Union Workhouse, Infirmary, and other buildings. Particulars from, and tenders to, Mr. W. Speckett, Clerk, Union Offices.

Poplar.—July 24th. The Electricity Committee wants tenders for high tension continuous current transforming plant, and switch gear; also for a year's supply of arc lamp carbons. See "Official Notices" to-day.

Spain.—July 26th. The Spanish Ministry of Industry and Public Works in Madrid are inviting tenders until the 26th inst., for the construction and working of an electric tramway between El Santuario de la Yedra and the station at Balza (province of Jaen). Particulars may be obtained from, and tenders are to be sent to, El Ministerio de Agricultura, Industria, and Obras Publicas, Madrid.

Spain.—July 30th. Tenders are being invited until the 30th inst. by the Spanish Ministry of Public Works in Madrid, for the construction and working of an electric tramway between Cadiz and San Fernando with a branch to La Carrara. Particulars may be obtained from, and tenders are to be sent to, El Ministerio de Agricultura y Obras Publicas, Madrid.

Spain.—The municipal authorities of Lepe (province of Huelva) have just invited tenders for the concession for the electric lighting of the town during a period of 20 years.

Stepney.—July 18th. The Borough Council wants tenders of steam and other pipe works, paper cables, conduits, &c. See "Official Notices" June 28th.

Yarmouth.—July 27th. The Corporation wants tenders for poles, brackets, wire, insulators, overhead equipment and rail bonding; battery, switchboard and booster; also cables and joint boxes, for the electric tramways. See "Official Notices" to-day.

CLOSED.

Aberdeen.—The Town Council has accepted the tender of Messrs. Wm. M'Kinnon & Co., at £3,781, for the structural iron and steel work in connection with the Ferryhill Electricity Works.

Barking.—We give below a list of the tenders submitted to the U.D.C. for condensing plant, that of Messrs. Allen being accepted including a Koppel Tower. Several firms sent in alternative tenders for steam driven plant, but the figures we print are only

who had charge of the undertaking had in reality to construct an entirely new system. The conductors, protected by lead piping,

ment last week, said that the commencement of the construction of the Pacific cable was an accomplished fact; the contract had

for electrically driven plant, according to specification. The cooling tower is open type, low lift, natural draught:—

Name.	Particulars.	£	Total. £
Arthur Koppel, 27, Clements Lane, E.C.	Natural draught tower Condensing plant ..	305 1,080	1,385
Messrs. Allen & Son, Bedford.	Koppel tower .. .. Condensing plant .. Edward's pump .. Baker separator ..	£305 1,750	2,055
Klein Engineering Company, 93, Market Street, Manchester.	Natural draught tower Condensing plant ..	377 1,688	2,065
Messrs. Mirrlees, Watson Company, Glasgow.	Condensing plant .. afterwards corrected to Koppel Tower.. ..	2,148 1,728 340	2,488 2,068
Wheeler Condensing Company, Queen Victoria Street, E.C.	Tower .. .. .. Condensing plant ..	878 1,696	2,574
Worthington Pumping Engine Company, Queen Victoria Street, E.C.	Tower .. .. .. Condensing plant ..	920 1,816	2,736
Pulsometer Engineering Company, Nine Elms Ironworks, S.W.	Condensing plant only	1,744	1,744
Messrs. John Fraser & Co., Millwall.	Evaporative E. condensing plant		2,375
Messrs. Doherty & Donat, Manchester.	Tower only	490	490

Engineer's estimate £2,000.

Chatham.—The following is a list of tenders sent in to Messrs. Harrap, Hewitt & Duffield's specification for the electric lighting of the premises of Messrs. G. H. Leavey & Co., Limited, Chatham:—

Messrs. Chard & Co., London (accepted)	£439 14
Mr. Thomas King, Maidstone	442 15
Messrs. Claud Hamilton, Limited, Glasgow	466 12
Messrs. Chapman & Co., Chatham	492 10
Messrs. Rawlings Bros., Limited, Blackheath.. ..	546 0

Monmouth.—The Town Council has accepted the tender of Messrs. Siemens Bros. & Co. for electric lighting work at the Grammar and High Schools at a cost of £443. The firm has undertaken to replace 1,050 yds. of defective high tension mains.

Nelson.—We give below particulars of tenders which have been submitted to the Corporation for electrical plant, and in some cases the accepted ones are indicated. Mr. W. A. Fraser is the borough electrical engineer:—

STEAM DYNAMO (Engineer's Estimate, £2,100). (NELSON).

Tenderer.	Engine maker's name.									
	Willans & Robinson.	Clayton.	Belliss 2-crank.	Belliss 3-crank.	Galloway.	Browett.	Alley & McLellan.	Reavall.	Allen & Son.	Brush.
British Thomson-Houston Co.	£2,406	..	..	..	..	£2,242	..	..	..	..
Phœnix Dynamo Co.	£2,397	..	..	£2,597	..	..	£2,197	..	..	..
Bruce, Peebles & Co.	£2,180*	..	..	£2,436	..	£1,895	..	..	..	..
Johnson & Phillips	£2,170	..	..	..	..	..	..	..	..	..
Greenwood & Batley..	£2,102	..	..	..	..	..	£1,800	..	..	..
Electric Construction Co.	£2,102	..	£2,244	£2,466	£1,890	£1,975	..	..	..	..
T. Parker, Limited	£2 088	..	..	..	£1,855	..	£1,868	..	..	..
Geipel & Lange	£2,060	..	..	£2,505	..	..	..	£2,090	£2,100	..
Crompton & Co.	£2,003	..	..	..	£1,785	£1,893	..	..	..	..
Mather & Platt	£2,000	..	£2,170	£2,360	£1,750	£1,830	..	..	..	..
Siemens Bros. & Co.	£1,970	..	£2,085	£2,300	..	£1,832	..	..	..	..
International Electric Co.	£1,969	£1,877	£2,161	£2,376	£1,650	£1,785	..	..	£1,822	..
Laurence, Scott & Co.	£1,943	..	£2,065	£2,231	..	£1,675	£1,685	£1,905	£1,925	..
T. Barton	£1,942	..	..	..	..	..	£1,750	..	..	..
Johnson-Lundell Co.	£1,874	..	..	..	..	..	..	..	..	..
F. Suter & Co...	£1,835	..	..	..	..	..	..	..	..	..
British Schuckert Co.	£1,768	..	£2,092	..	..	..	..	..	£1,777	..
Clayton Engineering Co.	..	£1,904	..	..	..	..	..	..	..	..
Lancashire Dynamo Co.	..	..	..	..	£1,701	£1,811	..	..	..	..
W. H. Allen & Co.	..	..	..	..	..	..	..	..	£1,787	..
Brush Electrical Engineering Co. ..	..	..	..	..	..	..	..	..	..	£2,280

* Bruce, Peebles & Co.'s tender (Willan's engine) accepted.

28-KW. BALANCER (ENGINEER'S ESTIMATE, £250).

Frank Suter & Co.	£457	0	0	Electric Construction Company	£290	0 0
Crompton & Co.	430	0	0	Thomas Parker, Limited	280	0 0
Siemens Bros.	430	0	0	J. Barton	272	0 0
The British Westinghouse Company	362	0	0	Phœnix Dynamo Company	268	0 0
Read, Holliday & Sons ..	340	0	0	Laurence, Scott & Co. ..	260	0 0
Mather & Platt	324	0	0	Morley Electrical Engineering Company ..	225	0 0
The British Thomson-Houston Company ..	323	0	0	Greenwood & Batley ..	209	10 0
Bruce, Peebles & Co. ..	319	0	0	British Schuckert Company..	203	10 0
Lancashire Dynamo and Motor Company	309	0	0			

Tenders Not Yet Settled.

CABLES (SOLID SYSTEM).

W. T. Glover & Co., Limited ..	£9,649	W. T. Henley's Telegraph Co.	8,699
Callender Cable Co. (*accepted*)	9,560	St. Helen's Cable Company ..	8,681
Telegraph Manufacturing Co.	9,543	Western Electric Company ..	7,816
British Insulated Wire Co. ..	9,007		

TWO 30 FT. BY 8 FT. LANCASHIRE BOILERS (ENGINEER'S ESTIMATE, £1,066).

	Boilers.	Weir pumps and economisers.
James Carter & Sons	£1,360	£640
Davey Bros.	1,195	530
Meldrum Bros.	1,163	573
Yates & Thom	1,134	566
Anderton & Sons	1,115	538
Tinkers, Limited	1,040	540
Danks & Co.	1,005	525

TRAVELLING CRANE (ENGINEER'S ESTIMATE, £200).

T. Broadbent & Sons	£345	Carrick & Ritchie (*accepted*) ..	205
J. Spencer & Co.	246	Rushworth Bros.	205
James Carrick & Sons	215	Herbert Morris & Bastert ..	198
Marshall, Fleming & Jack ..	215		

Stafford.—Messrs. Siemens have accepted the tender of Mr. Thomas Godwin, builder, of Hanley, the amount being £5,000, for laying the foundations of the buildings of their new electrical works.

London.—The London County Council on Tuesday considered the following tenders for the supply of steam, feed and other piping required in connection with the new high pressure boilers at the Western pumping station:—

Meehan & Sons (accepted)	£2,605
Alton & Co.	2,770
Wenham & Waters, Limited	2,790
Sir Hiram Maxim Electrical Engineering Company, Limited	2,888
The Lighting Corporation, Limited	3,256
Babcock & Wilcox, Limited	3,308
General Engine and Boiler Company	3,375
John Cochrane	3,400

NOTES.

Obituary.—The death is announced of Mr. Albert H. Johnson, an American railway magnate, who was interested in the Baker Street underground electric scheme. He was connected with a New York syndicate which had extensive designs on London electric traction schemes. Death was due to heart disease.

We regret to record the death of Prof. P. G. Tait, who had for over 40 years occupied the chair of Natural Philosophy at the Edinburgh University. He was 70 years of age, and it seems that he had never been able to recover from the shock received when his son died out at the war early last year. He was the writer of many important scientific and philosophical works, some in conjunction with Lord Kelvin, and was known as one of the greatest authorities on natural philosophy. His various text books on mathematical and physical science on light, heat, properties of matter, kinematics, &c., will long keep the mind of Tait in touch with that of the scientific student and thinker.

Correction.—We are requested to state that the three-phase alternator coupled to a blast furnace gas engine, which we illustrated last week in connection with Mr. Thwaite's article on the generation and distribution of electrical energy, was designed and constructed by Messrs. Brown, Boveri and Co., not by Messrs. Lahmeyer.

Life of Telegraph Wires.—An interesting specimen of iron telegraph wire, which has been in operation near Harrogate for 23 years, has been forwarded to us by a correspondent. It would probably have lasted longer but for a violent storm. The original gauge of the wire was No. 10 S.W.G., but corrosion had reduced it to something like No. 16. It is, however, still very tough and difficult to break.

New Lamp.—A high efficiency high pressure incandescent lamp is, we hear, about to be brought before the public.

for surface condenser, &c., and fan for induced draught. See "Official Notices" July 5th.

accepted including a Koppel Tower. Several firms sent in alternative tenders for steam driven plant, but the figures we print are only

Appointments Vacant.—A resident electrical engineer is wanted for Whitby at £200 per annum; an assistant superintendent of telegraphs for the Indian Government; a senior demonstrator in electrical engineering and applied physics, and an instructor in electrical engineering, with polyphase and high voltage experience, at Finsbury Technical College. The East Ham U.D.C. wants a central station clerk at £120 per annum.

Opening of Luton Electricity Works.—On Wednesday this week the electricity works which have been put down by the Corporation were opened with the usual ceremonial, and luncheon at the Town Hall.

With the Institution in Berlin.—In continuation of our notes of last week on the Berlin tour, we may add a few lines as to the subsequent events. On Wednesday, 3rd inst., the party reluctantly left Nuremburg at the early hour of 7 o'clock in the morning. The long journey to Frankfurt was relieved by the pleasant company on board, and a few interesting incidents by the way, including a bird's-eye view of that great engine-building centre, Chemnitz. The demand for the comparatively scanty supply of sandwiches and "bier" at the stopping stations created a new form of sport for the visitors, who were to be seen making bold, if not graceful, dashes at the happy, though somewhat bewildered, waiter, whose burden so rapidly vanished. At Frankfurt the company were most hospitably received, and entertained at lunch at the Bristol Hotel by the leading members of the Lahmeyer Company. Later in the afternoon a visit was made to the busy factory of the same company. An entry was made to the works through an archway formed by alternator armature frames. Among the important work seen here were parts of the four 3,000-KW. three-phase alternators, and a large number of 500-KW. motor-generators, which are being supplied for the City and Charing Cross scheme. The Electrizitäts Actien Gesellschaft vormals W. Lahmeyer and Co., have their numerous shops well filled with men and work. Sufficient orders are in hand to last for two years. The works find employment for 2,100 men and a staff of 756. The offices and workshops occupy a site of some 28,750 square metres. In the evening a dinner was given at Palmer Garten by the Electrotechnical Society of Frankfurt. It is interesting to remark that the hosts nearly all spoke in the English language. Prof. Hartmann's speech welcoming the visitors was followed by an exhibition of the "speaking arc." This arc lamp played softly, but distinctly, the tune of the National Anthem. Mr. Alex. Siemens again called for cheers, given heartily, for the hosts. Mr. Raworth replied to the toast "the Ladies," and referred to the overwhelming attention shown to them throughout the tour. Following the admirable programme on Thursday, a visit was paid to the single-phase power and light station at Speicher Strasse. Just sufficient time was spent here to examine the plant, which aggregates about 9,000 KW., including the latest generators supplied by Brown-Boveri and driven by Sulzer engines. We especially noted the liberal space which was allowed for the plant. An example of the load was seen by visiting a pumping station and some electrically driven lifts, and especial interest was aroused by a well-arranged sub-station containing three 500-KW. motor-generators and a buffer battery for tramway load. In the afternoon a few members of the party visited Wiesbaden combined three-phase alternating and continuous current station, while others, by special invitation, saw the works of Messrs. Hartmann & Braun, the exhibit of testing instruments there seen being particularly interesting and complete. At the factories of Voigt & Haeffner, switch manufacturers, some very interesting experiments with H.T. currents were shown, including a 5,000-volt fuse blowing, and an 80,000-volt arc. The majority of the party left for Hamburg, where, after viewing the Lahmeyer Company's generating station, they were entertained at dinner. On Thursday a small party, including Mr. Alex. Siemens, took train to Cologne, and from thence to the Elberfeld and Barmen Railway. The bulk of the company took steamers down the Rhine. Only about half a dozen were left at Cologne to visit Essen on Saturday, others gladly leaving on the return journey to the Old Country, *viâ* Hook of Holland and Harwich. The last of the very enjoyable, though hardly worked expedition, was to be seen at Liverpool Street Station struggling with luggage in the gentle hands of Custom House officers.

Personal.—The General Purposes Committee of the Wolverhampton Town Council have recommended that the salary of Mr. Shawfield, borough electrical engineer, should be increased from £300 to £450. Mr. Shawfield was provisionally appointed in July, 1898, at a salary of £200, which was increased to £300 in July, 1899, when his formal appointment to the office was confirmed. During the three years that have elapsed since he was first appointed the work of the electric lighting department has considerably increased. Large extensions of the generating plant and distributing system have been designed by Mr. Shawfield, and carried out at a cost of about £50,000. In addition, he has also drawn up the whole of the plans and specifications for the complete electrical equipment of the new tramway undertaking, and these works will be carried out under his supervision. The Committee add that Mr. Shawfield has performed the whole of the extra work in connection with the tramway scheme with great tact and ability, and without any additional assistance.

We learn that Mr. H. G. Cheesman, of the Eastern Telegraph Company, has just returned to England after a tour of 16 months spent in inspecting the Western and Pacific and European Companies' Stations.

By the resignation of Sir Alexander Binnie of the position of chief engineer to the London County Council, that body loses its most valuable and, we believe, its most valued official. Sir Alexander has during his 11 years of office carried out many very large and important undertakings for the L.C.C. with conspicuous success. He is to relinquish his appointment in December in order to start in private practice, and it is stated that his two sons will be associated with him in his new enterprise.

The Council of University College, Liverpool, have elected Mr. Edgar Walford Marchant, D.Sc. (Lond.) to the Lectureship in Electrotechnics, which recently became vacant by the appointment of Mr. Alfred Hay to a professorship at Cooper's Hill. Dr. Marchant was educated at the Central Technical School, London. For more than two years he assisted Lord Blytheswood in his laboratory and workshop, Renfrewshire, and since June, 1900, has been senior demonstrator at the Finsbury Technical College under Prof. Silvanus Thompson.

On Saturday night Mr. J. A. Jeckell, who for the past eight years has had charge of the South Shields Corporation electric lighting department, was presented with a gold watch and chain and other handsome presents by the officials and employés, on the occasion of his leaving that town to go to Coventry to take charge of the electric light works there.

Mr. F. W. Dunning, whose marriage we announced last week, is not chief electrical engineer at the Melton Mowbray electricity works, that position being held by Mr. W. H. Russell. Mr. Dunning is assistant-in-charge.

Mr. R. Spencer Yates, assistant engineer of the Oswestry Electric Light and Power Company, has been appointed by the U.D. Council of Sleaford to be resident engineer of the Sleaford electricity works.

Fatality.—A fatality occurred in connection with the Manchester electric tramways on Tuesday morning. A wireman, named Benjamin Horn, was at work at the Boggart Hole Clough terminus in connection with the alteration of the adjustment of a "frog," when he received an electric shock which caused him to fall from a ladder and fracture his skull. The man had ascended a ladder, which he had placed against one of the poles, and without using rubber gloves (which are provided) he took hold of a "pull-over wire" which had become "live" owing to an insulator having been removed. The shock itself, it is said, would not have killed him, but the fall which followed produced very serious injuries to his head, and these caused his death before he could be removed to the Infirmary.

A Very Free Lance!—"As an instance of the pseudo-scientific rubbish we are so constantly treated to by the lay papers," says a writer in the *Free Lance* of the 7th inst., "we were told that a 'short circuit' of 'electric wires' was responsible for a fire. An electric current for the want of, or for the breaking down of, proper insulation, may become 'short circuited,' and so cause 'sparking,' and thus a blaze, but if the insulation is satisfactory, and the wire does not offer too great a resistance, an electric current can be sent over a long or short circuit with equally satisfactory results." As an instance of the blind leading the blind, this would be hard to beat. Fancy the *Free Lance* taking to task its lay contemporaries for their pseudo-science! That lay paper was perfectly correct; short circuits of electric wires have been responsible for many outbreaks of fire, and the expression "short circuit" has nothing whatever to do with the length of the wires. The *Free Lance* writer seems wholly unconscious of the utter absurdity of his attempt to enlighten the lay papers, but where ignorance is bliss, &c.

The West London Electric Trams.—The progressive spirit which has been displayed by the London United Tramways Company ever since it first stepped out in the direction of electric traction, was well honoured on Wednesday this week at the very brilliant function which was held at Chiswick to celebrate the inauguration of certain trolley extensions. As our readers are already aware, some miles of electric lines have been in operation in West London suburban districts since about last Easter, but the customary inaugural ceremonial was deferred until this week, when the opening of extensions to Brentford, Hounslow, Acton and Southall was celebrated. The very large party of guests, included Lord Lansdowne, Lord Grey, Lord Rosse, Lord Herries, Lord Rothschild, Lord Revelstoke, Lord Hillingdon, Lord Mountstephen, Mr. Arthur Balfour, M.P., Sir John Kennaway, M.P., Sir Henry Marchant, M.P., Sir William Preece, Sir E. Cassel, Sir Benjamin Baker, Mr. T. Skewes-Cox, M.P., Mr. W. J. Bull, M.P., Mr. R. W. Perks, M.P., Mr. C. T. Yerkes, Sir Hiram Maxim, and many other distinguished personages. The toast of "The London United Tramways Company" was proposed by Mr. Balfour, who, in an interesting speech, dwelt upon the enormous advantages conferred upon the public by these up-to-date means of street locomotion. Mr. George White replied to the toast. Prof. Silvanus Thompson then proposed the health of the managing director and engineer of the company, Mr. J. Clifton Robinson, after whose reply the proceedings came to an end. Previous to the luncheon, which was spread in the capacious and splendid power house at Chiswick, the party proceeded over the gaily decorated route to Southall and back in a number of the new cars. So far the L.U.T. Company has 15 miles of electric tramways running, but those who are acquainted, as most of our readers must be, with the enormous undertakings of the company which have been so energetically pushed forward for years past by Mr. J. Clifton Robinson, will know that this is but a small portion of the work arranged for.

Meters for Kimberley.—The borough electrician of Kimberley lately reported as to certain meters required, and the quotations received for supplying same. He recommended that the offer of Messrs. Reunert & Lenz, who gave the most favourable terms, be accepted. From the figures given, it appeared that the meters could be obtained through several sources in the Colony at a cheaper rate than the terms the Council were asked for meters specially imported on their behalf. The matter being urgent, Councillor Henderson moved that the meters in question be purchased, and that all information with reference to the matter be laid before the Lighting Committee. This was agreed to.

Submarine Boats.—The *Standard* says that "Preparations are being made at Portsmouth for exhaustive experiments with the submarine boat which, on completion, is to proceed to that port. A submarine electric light searcher has been tried by the staff of the *Vernon* torpedo school ship."

CITY NOTES.

British Electric Traction Company.

The fifth ordinary general meeting of the shareholders of this company was held on 4th inst. at Hamilton House, Victoria Embankment, Sir Charles Rivers Wilson, G.C.M.G., C.B., presiding.

The Chairman, in proposing the adoption of the report, said that the year under review had been a period of great activity for the company, with the result that they had largely developed and extended the business; that the financial position had been greatly improved and strengthened, and that an increased dividend was available for distribution among the shareholders. In considering the accounts, they must remember that they only covered a period of 12 months, whereas the previous ones were for 15 months. The gross profits for the last 12 months had amounted to £157,382, including £43,783 brought forward, but not including the premiums received on the issue of new shares. After paying all expenses and the interest on the debenture stock, there remained a balance of £116,947 available for distribution. The dividend on the preference shares would take £34,256, and 9 per cent. for the year on the ordinary shares which the directors recommended should be paid, would take another £55,866. As the shareholders were aware, an interim dividend at the rate of 6 per cent. was paid last September, and the directors now recommended a final payment at the rate of 12 per cent., making 9 per cent. for the year. The goodwill account now stood at £5,000, and they proposed to reduce that by £2,500, and they also proposed that the amount standing against the cost of licenses and the testing of new systems should be reduced by a like sum, which would leave £21,457 to be carried forward. In addition to the profits on trading, £128,855 had been received in respect of premiums on new share capital. That had been carried direct to the reserve fund which now stood at £338,520. In considering the results of the year's working, it must be borne in mind that a very large amount of capital had been employed in the construction of new tramways and light railways which had only just recently been opened for traffic, and therefore that large expenditure had produced no revenue for the past year, but it would doubtless materially improve the revenue of the current year. Upwards of 45 miles of new lines had been opened for traffic since the interim report which was issued to the shareholders last November, and when they remembered that the capital outlay on those lines averaged about £12,000 a mile, they would see that over half a million of capital had brought in little or no revenue during the past year. The amount of engineering work executed during the year had been very considerable. Since their last annual meeting their various associated companies had opened for traffic nearly 60 miles of new or reconstructed tramways and light railways, and several electric light stations had commenced to supply electricity. They had also obtained Acts of Parliament and orders during the year for the construction of some 80 miles of tramways, which they would proceed with according as their finances permitted. The works for which they had obtained powers were as follows:—South Staffordshire light railways, 7 miles; Wellingborough tramroads, 19 miles; Peterborough light railways, 5½ miles; Christchurch tramways, 4½ miles; Gateshead light railways, 2½ miles; Weston-super-Mare tramways, 3½ miles; Morley and District light railways, 8⅜ miles; Spen Valley light railways and extensions, 19 miles; Sheerness and District light railways, 2½ miles; Worcester and District light railways, 4¾ miles; and Barnsley and District light railway extensions, 3 miles. They had also obtained light railway orders, granted subject to the approval of the Board of Trade, for the following:—Durham and District, 2⅝ miles; Jarrow and South Shields, 3¼ miles; Kidderminster and Bewdley 3⅝ miles; Potteries, 5¾ miles; Rhondda Valley, 2¾ miles; Wigan, 4 miles; and Worcester, 4 miles; in all between 26 and 27 miles. That would bring home to the minds of the shareholders the very large amount of work which the company was doing and which it had in prospect. It would doubtless be interesting for them to know the precise amount of mileage which the company now had in operation. In all they had about 238 miles of lines actually in operation; of these about 118 were worked by electricity, 56 by steam, and 64 by horse-power. Many of the horse and steam lines were now in course of being converted into electrical lines. They also had either in operation, or in course of construction or promotion, over 440 miles of tramways and light railways, and that did not include about 40 miles of omnibuses. The aggregate traffic receipts last year from all the lines were about £600,000, made up for the most part of 1d. and 2d. fares, and the number of passengers carried during the year was about 100 millions. Passing to the accounts, the chairman said that the subscribed share and debenture capital at the date of the last meeting was £1,300,000, and it has now risen to £2,120,740, and as Messrs. J. S. Morgan & Co. and the Electric and General Investment Company would exercise forthwith the option which had been given them to take up the unissued share capital, the total present subscribed capital might be put at £2,000,000 in shares, and £600,000 in debenture stock, which left the directors power to issue another £400,000 of debenture stock. For some time the directors had felt the necessity of having some central establishment where they could obtain with economy and facility all the necessary appliances for their business. At one time they had contemplated erecting such an establishment themselves, but there were objections to that course, and they had given up the idea. They then remembered the very friendly relations they had always enjoyed with the Brush Electrical Engi-

about half a dozen were left at Cologne to visit Essen on to the Infirmary.

neering Company, and they approached that company to see whether it would not be possible to make some combination which would be of a profitable character to both companies. They were met in a very cordial and straigthforward spirit by the Brush Company, and the result was that they arranged to acquire a certain substantial holding in the shares of that company, and he believed the combination would be satisfactory and advantageous to both parties. In conclusion, the chairman explained at some length the proposals which the company had adopted for the purpose of creating a sinking fund to meet the falling in of their various concessions.

The Hon. Sir Charles W. Fremantle seconded the motion.

Considerable discussion ensued, during which Mr. E. K. Smart animadverted very strongly upon the conduct of the board in respect to the arrangement entered into with Messrs. J. S. Morgan & Co. and the Electric and General Investment Company for the unissued capital, and complained that it had not been offered to the existing shareholders.

The Chairman, in reply, pointed out that in the past the directors had relied upon the shareholders to find additional capital and had been disappointed. It was of the greatest importance to the stability of the company that the money should be assured, and therefore he considered that the arrangement they had made was to the advantage of the company generally.

The report was then adopted.

Thomas Parker, Limited.

The annual meeting of this company was held on Monday afternoon at the works, Wednesfield Road, Wolverhampton.

The Chairman of the company (Alderman C. T. Mander) presided, and in moving the adoption of the report he said that it needed no comment on his part. They proposed to pay a dividend of 10 per cent. As a board, they were very satisfied with the year's trading, especially when they remembered the high price of some of the raw materials and coal. They had written off the usual amount for depreciation in the ordinary way, and they proposed to carry forward £2,500 to the reserve fund, bringing it up to £17,500, and to carry the balance forward to the next year's account, which, he thought, was very satisfactory.

Mr. T. Parker seconded the resolution, and said that he thought the result was as satisfactory as the shareholders expected it would be.

Mr. Elton observed that the company had made £3,000 less profit than last year, and £3,000 less than the year before, making £6,000 in two years. In the same period some thousands more debentures had been borrowed. If that was a small company, and they went on at the same rate, they would soon be in the hands of the debenture holders alone.

The Chairman said he did not wish to go into details, but during the year there had been an increase of £4,155 in the cost of raw material, which would, in some measure, account for the difference.

In reply to another shareholder, the Chairman said £4,000 of debentures had been issued during the last 12 months.

The resolution was carried, as was also another agreeing to pay a dividend of 10 per cent.

Subsequently, an extraordinary meeting was held, when alterations were made in the articles of association in order to meet the requirements of the London Stock Exchange.

City and South London Railway Company.

The accounts for the half-year ended June 30th show a balance, after providing for debenture interest, and transfer to a renewal fund of £2,000, and the dividends on the preference stocks, sufficient to allow of a dividend on the consolidated ordinary stock at the rate of 1¾ per cent. per annum, carrying forward a balance of £732. The dividend for the corresponding period last year was at the rate of 1¼ per cent. per annum, the balance carried forward being £788.

May-Oatway Fire Appliances, Limited.

The statutory meeting was held on 9th inst., at 53, New Broad Street, E.C.

Sir Eyre Shaw, K.C.B., the chairman, said that since the registration of the company practically three months had passed, and he regretted that the material necessary for the commencement of operations was only then coming to hand. Delivery of stock was, however, promised for the 12th, and the selling and canvassing staff was being engaged, and would be kept actively at work from now on. The interval had been utilised in exhibiting the invention in the North, and some progress had been made with the formation of a subsidiary company for Lancashire and Yorkshire. The license of the Postmaster-General had been granted to the company by deed.

Aron Electricity Meter, Limited.

We understand that it is intended to make very shortly an issue of 5 per cent. debentures by Aron Electricity Meter, Limited, to the extent of £60,000, at an issue price of 95 per cent. The company has largely extended its operations, and it has been found necessary to start workshops in England for the manufacture of meters in this country, and new factories have also been erected in Schweidnitz, Germany, being fitted with the latest appliances for the most economical production of the meters. The Berlin works have been considerably extended. The erection of a new branch factory in Buda Pesth is also in contemplation, and thus the additional capital is required for the growing business. We have no doubt that this additional capital will be readily subscribed.

West African Telegraph Company, Limited.

The report for the year ended December 31st states that the revenue amounted to £81,567, against which £20,387 is charged for ordinary expenses and £9,034 for expenditure relating to repairs of cables, &c. The total available balance is £52,007, from which there has been deducted debenture interest and £15,766 for sinking fund, leaving a balance of £28,322, out of which £28,000 is placed to general reserve fund. The revenue for the year includes £12,000 in respect of subsidy due from the French Government, but which has not yet been paid. This arrear, together with the sums withheld in previous years, now amounts to £68,415. Under these circumstances, the directors have entered into provisional negotiations with the French Government for the purpose of surrendering to them the French concession now held by the company, together with the property now belonging to the company in connection therewith.

Edmundson's Electricity Corporation, Limited.

The directors' fourth annual report to March 31st, 1901, presented to the meeting held yesterday afternoon at Westminster, reads:—

"Including the sum of £4,158 2s. 7d. brought forward from last year, the net profit, after payment of debenture interest, amounts to £26,699 5s. 7d. After deducting dividend on the preference shares, paid and accrued, amounting to £1,719 3s. 6d., and an interim dividend at the rate of 5 per cent. per annum on the ordinary shares amounting to £4,215 13s., there remains a balance of £20,764 9s. 1d., which the directors recommend should be appropriated as follows:—

	£	s.	d.
To a final dividend on the ordinary shares at the rate of 9 per cent. per annum, making 7 per cent. for the year..	7,937	10	0
To dividend on the deferred shares of 7 per cent. for the year	1,575	0	0
In further reduction of goodwill account	5,000	0	0
To creating a reserve fund	4,000	0	0
Leaving to be carried forward to next account	2,201	19	1
	£20,764	9	1

The profits of the corporation continue steadily to improve, and the directors wish to call attention especially to the considerable increase in the income from dividends and interest which amount this year to £11,108 1s. 4d., as against £4,438 18s. 4d. last year. Profit from electric lighting being, under good management, invariably progressive, this portion of the corporation's income may be expected to improve from year to year. An interesting reprint from *Lightning* is enclosed, giving particulars of the working of our principal stations for last year taken from the official returns of the Board of Trade. Since the last report central stations at Melton Mowbray, Lymington, Montrose, Brechin, and a joint station for Sandown and Shanklin have been opened and are working satisfactorily. Parliamentary powers have been obtained for electric lighting and tramways for a number of towns in the name of the Urban Electric Supply Company, which company has now obtained its capital, and this corporation has entered into a valuable contract for carrying out the various works required. The private house installation business shows a satisfactory increase. The shares in the local companies in which the corporation is interested have been taken in the balance sheet at cost price. During the year 20,000 6 per cent. preference shares and £45,000 additional debenture stock have been issued. One of the directors, Mr. J. W. Edmundson, retires by rotation and is eligible for re-election. The auditor, Mr. W. H. May, offers himself for re-election."

Electric Securities in France.

The Paris correspondent of the *Financial Times* quotes from a French paper the following table showing the depreciation in 12 months of the principal public transport and electric construction and traction securities quoted on the Paris Bourse:—

	Price July 1st. 1900. Francs.	1901. Francs.
Paris General Omnibus Company	2,000	945
Cie. Générale de Voitures	425	152
Thomson-Houston Electric	1,361	1,095
General Traction Company	230	54
Omnium Lyonnais..	95	62
Est Parisien	564	255
Cie. Générale Parisienne de Tramways	390	310
Cie. Générale Francaise de Tramways	950	600

Harrow Electric Light Company.

The directors' report presented at the annual meeting held on 9th inst. at Harrow, says that it has been impossible to keep down the works costs owing to the very high price of coal. The price of current was not increased. Mains extensions had been carried out and the increase of business was steadily maintained. The 4½ per cent. preference shares were well taken up, and the 4 per cent.

school ship."

up the idea. They then remembered the very friendly relations they had always enjoyed with the Brush Electrical Engi-

debentures were increased from £10,000 to £15,000. The directors opposed the North Metropolitan Electricity Supply Corporation scheme. The Corporation has not secured powers to supply private individuals, and the directors consider that the shareholders' interests are sufficiently protected. The battery has had to be replaced at a cost of £800 to £900, and the maker will maintain it for 10 years under contract. This fact led the board to place a larger sum to depreciation than they had originally intended. £1,648 is available for distribution, and of this £1,000 is placed to depreciation. Only the interest on the preference capital (£328) is paid, and the balance, £320, is carried forward.

Prospectuses.

THE list of subscriptions closed on Wednesday in an issue of £250,000 4 per cent. debenture stock at £103 in the Central Electric Supply Company, Limited. The stock is secured by a first charge upon the undertaking of the company, and by the joint guarantee of the St. James's and Westminster Supply Companies. The objects of the company are pretty familiar to readers of the ELECTRICAL REVIEW. The two companies are jointly erecting a large station for furnishing sufficient energy for 250,000 8-C.P. lamps for supplementing the existing supply from their several stations now in operation.

An issue of 4,500 £1, and 63,500 5½ per cent. £1 preference shares in the Gandy Belt Manufacturing Company, Limited, of Wheatland Works, Seacombe, Cheshire, required for extension of business, has been before the public for subscription this week, the list closing on Wednesday. The Gandy belt is made of hand-woven canvas and is said to be in large demand. It is stated that the manufacture of a new machine belt prepared with "Velvril," a patent composition, is also to be proceeded with.

It is stated in the daily papers that S. Z. de Ferranti, Ltd., electrical engineers, Hollinwood, is about to be reconstructed, and mortgage debenture stock and £100,000 6 per cent. cumulative preference shares will be offered for public subscription. The vendors take no cash out of the business, leaving the extra capital provided by this issue entirely available for working capital and the general purposes of the business.

Stock Exchange Notices.—The Committee has ordered the undermentioned securities to be quoted in the Official List:—Central London Railway, £1,969,800 ordinary stock, £440,100 4 per cent. preferred stock and £440,100 deferred stock, in lieu of the shares now quoted; Oxford Electric Company, Limited, £50,000 4 per cent. debenture stock. The Committee has been asked to allow the following securities to be quoted in the Official List:—British Electric Traction Company, Limited—Further issue of £250,000 5 per cent. perpetual debenture stock. Johnson-Lundell Electric Traction Company, Limited—40,000 shares of £5 each, £3 paid, Nos. 1 to 7 and 20,008 to 60,000. London United Tramways, Limited—£350,000 4 per cent. first mortgage debenture stock, in lieu of the provisional certificates now quoted. Thomas Parker, Limited—7,500 ordinary shares of £10 each, fully paid.

Telegraph Construction and Maintenance Company, Limited.—An interim dividend of 12s. per share is announced.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending July 5th were £531; corresponding week last year, £486; increase, £45. Total to date, £12,588, corresponding period last year, £11,489: increase, £1,100. Miles of track open, 8¾.

Birkenhead Corporation Tramways.—For the week ending June 23rd the electric cars carried 50,256 passengers, and the receipts were £242 14s. 9d. For the week ending June 30th the total of passengers carried was 53 877, and the receipts were £264 2s. 4d.

Blackpool and Fleetwood Tramways.—The receipts for six days ending July 6th were £785; corresponding week last year (seven days), £803; decrease, £16. Total to date (six days), £785; corresponding period last year (seven days), £803; decrease, £16.

Bristol Tramways and Carriage Company.—The receipts for the week ending July 5th were £4,873; corresponding period last year, £3,222 increase, £1,651.

Central London Railway.—The receipts for the week ending July 6th were £6,079; previous week, £6,144; decrease, £65. Total receipts to date (one week), £6,079. Miles open, 6.

City and South London Railway.—The receipts for the week ending July 7th were £1,972; corresponding week last year, £1,447; increase, £525. Total to date, £1,972; corresponding period last year, £1,447; increase, £525. Miles open, 4¾.

Dover Corporation Tramways.—The receipts for the week ending July 6th were £254 11s. 2½d.; corresponding week last year, £235 15s. 7d.; increase, £18 15s. 7½d. Total to date, £5,108 6s. 3d.; corresponding period last year, £4,737 5s. 4½d.; increase, £371 0s. 10½d. Miles of track open, 3. Car miles run, 1901, 5,082; 1900, 5,007. Number of cars, 11.

Dublin United Tramways Company.—The receipts for the 5 days ending July 5th were as follows:—D.U.T. Co., electric cars, £2,827 16s. 3d.; D.S.D. Co., electric cars, £661 6s. 11d.; total, £3,492 3s. 2d.; corresponding period last year—D.U.T. Co., electric cars, £2,442 8s 1d.; ditto, horse cars, £30 14s. 7d.; D.S.D. Co., electric cars, £611 2s. 5d.; total, £3,084 5s. 1d.; increase, £407 18s. 1d.; aggregate to date, £3,492 3s. 2d.; aggregate to date last year, £3,404 6s. 0d.; increase, £87 17s. 2d. The mileage worked is 45 miles electrically, as against 42 miles electrically, and two miles by horses, for the corresponding period last year.

Glasgow Corporation Tramways.—For the week ending June 29th, £11,988 11s. 7d.; corresponding week last year, £9,181 0s. 5d. For the week ending July 6th, £12,353 17s. 10d.; corresponding week last year, £9,408 13s. 5d. This latter sum—£12,353 17s. 10d.—now forms a record drawing for any week's result.

Liverpool Overhead Railway.—The receipts for the week ending July 7th were £1,732; corresponding week last year, £1,687; increase, £45. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

THE Stock Exchange can hardly boast of being in a happy frame of mind. Despite the cheapness of money, there are a number of causes all militating against the long-looked-for advance in investment markets. Rumours of financial trouble in Germany, industrial strikes in the United States, rioting in Argentina—these are a few of the present skeletons whose bones are rattling in the cupboards of Capel Court. Yet through all this uneasiness, which is by no means alleviated by a general dearth of business, the electrical departments are holding their ground with the utmost steadiness. In the supply section the position is practically unchanged, there being one fall to set against the two rises. Telegraph and telephone securities have a quartette of improvements to show against the single decline, and in the miscellaneous division the few falls are all insignificant. It will be observed that in dull days the electrical markets wax no duller; their prospects in brighter days are therefore so much the better.

The home railway market of the Stock Exchange is deeply depressed upon consideration of the forthcoming dividends. With the figures for the first half of the current year completed, the prophets are now able to fortell their worst, and pessimism, natural enough under the circumstances, reigns supreme. Waterloo and City Ordinary is sharing in the general weakness, and has lost a point, although the dividend will, of course, be at the usual rate of 3 per cent. per annum. Central London securities are quoted for the first time to-day, Wednesday, in stock instead of shares. The Ordinary and Deferred are both called 93 to 96, and the Preferred is 98 to 101. There is no quotable change in the price of City and South London stock or shares, despite the increased dividend, but Great Northern and City Preferred "A" are no better than 8, which is £2 per share discount. In the Underground stocks, Metropolitans unkindly advanced at the prospect of a change in the chairmanship of the company, but Districts are a dull market at 29½. There has been no such flutter in the stocks of the Yorkshire lines as took place in some of the Lancashire Railway shares upon the proposed advent of a new electrical competitor. In fact, the powerful North-Eastern Company is supporting the new scheme, which has now been passed by both Houses of Parliament.

London United Tramways 4 per cent. Debenture has advanced to 105¼, at which price there are buyers in the market. The stock is benefitting from the attention called to the company by reason of the new extensions. Several well-known members of the Stock Exchange attended the luncheon given on Wednesday by the company. Anglo-Argentine Trams have slipped back to 4¼, and British Electric Traction Ordinary are weaker, partially, it is said, in sympathy with American rails.

The electricity supply market finds that there are several sellers about of St. James's and Wesminster's. The latter shares are marked down 10s., and the motive advanced for the sales is that holders do not like their companies guaranteeing, in part, the new issue of Debenture stock which has been made this week by the Central Electric Supply Company. The latter's emission scored a distinct success, but no market exists for the stock. There is not so much as a fancy premium, but it is none the worse for that.

The telegraph market—with which is included that devoted to telephone descriptions—has hardened in several directions. Eastern Ordinary stock and Eastern Extension shares are both better, and National Telephone issues are also harder, the 3½ per cent. Debenture stock having put on a couple of points. The Anglo-American Telegraph group is affected by the break in New York prices, which occurred early in the week, but the Deferred is the only stock recordably changed, and that is but ¼ down. Other American cable shares are unaltered on the week.

As regards the manufacturing division, something of a set has been made at the senior stocks which it contains. Edison and Swan Second Debenture has fallen 2 per cent., and Callender's 4½ per cent. Debenture is lower to the same extent. Brush shares show a declining tone, but the Electric Construction report is held to be good, and the actual price is a shade harder, although the nominal quotation remains unchanged.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for he last three years.			Closing Quotations July 3rd.	Closing Quotation July 10th.	Business done during week ended July 10th. 1901.	
			1898.	1899.	1900.			Highest.	Lowest
96,900	African Direct Telegraph, 4 % Debs	100	...	...	...	98 —101 xd	98 —101 xd	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	78 — 83	78 — 83	...	...
822,700£	Anglo-American Telegraph	Stock	£3 9s.	73/6	3½ %	53 — 56	53 — 56	53	...
3,088,540£	Do. do. 6 % Pref	Stock	6 %	6 %	6 %	98 —100	98 —100	99⅜	98⅝
3,088,540£	Do. do. Deferred	Stock	18s. %	£1 7s.	5s. %	10 — 10½	9⅝ — 10½	10 3/16	9⅞
44,000	Chili Telephone, Nos. 1 to 44,000	5	3 %	4 %	...	3¾ — 4¼	3¾ — 4¼	...	...
13,333,300$	Commercial Cable	$100	8 %	8 %	...	175 —185 xd	175 —185	...	...
1,589,496£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	100 —102 xd	100 —102	101¼	101½
16,000	Cuba Telegraph	10	8 %	7 %	...	7 — 8	7 — 8	...	...
6,000	Do. 10 % Pref.	10	10 %	...	...	14½ — 15½	14½ — 15½	14½	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	3 — 4	3 — 4	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	9 — 10	9 — 10	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	99 — 103⅝xd	99 —103⅝ xd	...	...
60,710£	Direct United States Cable	20	3½%	3 %	3 %	10½ — 11½	10½ — 11½	11 3/16	10 13/16
104,300£	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102 xd	99 —102 xd	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	140 —145	141 —146	145½	144
1,826,888	Do. 3½ % Pref. Stock	100	...	...	...	89 — 92	89 — 92	90½	90
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	109 —113	109 —113	111½	...
300,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	13½ — 14	13¾ — 14¼	13 15/16	13¾
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	111 —116	111 —116	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	...	...	100 —103	100 —103	100¾	100½
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103%	100 —103%	...	...
180,227	Globe Telegraph and Trust	10	5⅛%	5¼%	...	9¾ — 10¼	9¾ — 10¼	10⅛	9⅞
180,042	Do. do. 6 % Pref.	10	6 %	...	...	14½ — 15½	14½ — 15½	15⅝	...
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	...	15 %	30 — 32	30 — 32	30¾	30⅜
78,000£	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102 xd	99 —102 xd	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	43 — 47	43 — 47	...	...
100,000£	London Platino-Brasilian Telegraph, 6 % Debs.	100	...	...	...	103 —106	103 —106	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	2½%	...	¼ — ½	¼ — ½	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	5 %	...	⅝ — 1	⅝ — 1	...	...
590,000	National Telephone, 1 to 590,000	5	6 %	5 %	5 %	3½ — 3½	3⅜ — 3⅝	3 9/16	3 7/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11 — 12	11 — 12	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 12	11 — 12	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅛ — 4⅜	4⅛ — 4⅜	4 5/16	4⅛
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	87 — 90 xd	89 — 92	...	...
500,000£	Do. 4 % Deb. Stock Red.	100	...	...	4 %	94 — 97 xd	95 — 98 xd	97	96¾
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	6 %	⅞ — 1	⅞ — 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	99 —102 xd	99 —102 xd	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	125 —130	125 —130	...	...
58,900	United River Plate Telephone	5	6 %	7 %	...	5 — 5½	5 — 5½	...	...
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4¾ — 5¼xd	4¾ — 5¼ xd	5 7/16	5 5/16
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	101 —104 xd	101 —104 xd	...	...
171,000	West African Telegraph, 5 % Debs....	100	...	...	...	98 —101	98 —101	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼ — ⅜	¼ — ⅜	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	99 —102 xd	99 —102	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	13⅜ — 14¼xd	13⅜ —14¼ xd	14 1/16	13¾
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	101 —104 xd	101 —104 xd	...	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	100 —103 xd	100 —103 xd	...	...
88,321	West India and Panama Telegraph	10	2 %	5%	...	⅜ — ⅝	⅜ — ⅝	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	5 — 6	5 — 6	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	3 — 5	3 — 5	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	101 —104 xd	101 —104 xd	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	6 %	7⅜ — 8¼	7⅜ — 8¼	...	...
12,000	Do. do. 7 % Cum. Pref....	5	...	...	...	8½ — 9	8½ — 9	...	...
50,000	Charing Cross and Strand Electricity Supply	5	8 %	9 %	9 %	9 — 10	9 — 10	9⅜	9 5/16
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5¼ — 5⅜	5¼ — 5⅜	...	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	5½%	5⅜ — 6¼xd	5⅜ — 6¼	5 9/16	5⅜
150,000£	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	107 —110 xd	109 —112	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	6 %	4 %	0 %	8 — 9	8 — 9	8½	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½ — 13½	12½ — 13½	12¾	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	120 —125 xd	120 —125 xd	123¾	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	4 %	4 %	8½ — 9½	8½ — 9½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	12 — 13	12 — 13	...	...
200,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	103 —106 xd	103 —106 xd	105½	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	6 %	7 %	5½ — 6	5½ — 5¾	5¼	5¼
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	5½ — 5¾	5½ — 6	5⅝	5 9/16
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	104 —107	104 —107	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	...	...	...	11½ — 12½	11½ — 12½	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	102 — 105	103 —105	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1½ — 1¾	1½ — 1¾	...	...
49,840	Do. do. do. do. 6 % Pref.	5	6 %	...	...	4 — 5	4 — 5	...	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	96 —100	96 —100	...	..
85,000	Metropolitan Electric Supply, 101 to 62,500	10	5 %	5 %	6 %	13 — 14	13½ — 14½	14	13½
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	108 —111 xd	108 —111 xd	...	...
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	94 — 97 xd	94 — 97 xd	97	...
6,452	Notting Hill Electric Lighting	10	6 %	7 %	7 %	15 — 16 xd	15½ — 16½	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½ — 15½	14½ — 15½	15½	14¾
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	..	...
150,000£	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	97 —100 xd	97 —100 xd	97	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2½ — 3½	2½ — 3½	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000... ...	5	12 %	13 %	10½%	12 — 13	11½ — 12½	12⅝	11⅝

* Subject to Founders Shares. Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‡ Dividends paid in deferred share warrants, profits being used as capital.
— Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation July 3rd.	Closing Quotation July 10th.	Business done week ended July 10th, 1901. Highest	Lowest.
		‡							
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	7 — 8	7 — 8	...	...
300,000*l*	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	89 — 93	89 — 93	...	...
45,000	British Electric Traction	10	6 %	8 %	9 %	15 — 16	14½ — 15½	15⅝	15⅛
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 13	12 — 13	12½	12⅜
350,000*l*	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	122 —125	122 —125	124¼	123¾
70,000	British Insulated Wire Ord.	5	15 %	20 %	15 %	10 — 11	10 — 11	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	6 — 6½	6¼ — 6⅜	6½	6⅜
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	2	5 %	6 %	...	1⅝ — 1⅞	1⅝ — 1⅞	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	...	2⅛ — 2⅜	2⅛ — 2⅜	2⅛	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	103 —108	103 —108	...	...
108,710*l*	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	99 —102 xd	101 —104	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	15 %	14 — 15	14 —15	...	...
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½ — 6	5½ — 6	...	...
90,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	109 —113	107 —111 xd	...	...
206,297	Central London Railway, Ord. Shares	Stock	...	...	...	9½ — 9⅝	93 — 96	...	...
78,703	Do. do. Pref. half-shares	5	...	...	...	4⅝ — 5¼	98 — 101	101	100
78,703	Do. do. Def. do.	5	...	...	...	4⅝ — 5¼	93 — 96	...	...
855,000	City and South London Railway	Stock	2⅛%	1⅞%	1¼%	54 — 56	54 — 56	55	54¼
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000	10	...	...	...	5¼ — 5⅝	5¼ — 5⅝	5¼	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	6 %	7½%	...	3½ — 4	3½ — 4	3½	...
100,000*l*	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	100 —105 xd	102 —107	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	...	1 — 1½	1 — 1½	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	...	2 — 3	2 — 3	...	...
344,023*l*	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	80 — 85 xd	87 — 89	...	...
100,000*l*	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	94 — 98	94 — 98	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6%	1⅜ — 2½	1⅜ — 2½	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	...	...	2½ — 3	2½ — 3	...	...
182,500*l*	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	100 —103	100 —103	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	14 %	15 %	20 %	15½ — 16½	15½ — 16½	16¼	15⅞
35,000	Do. do. do. 4½ % Pref.	5	...	4½%	4½%	5½ — 6	5½ — 6	...	...
50,000*l*	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	107 —111	107 —111	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	...	...
300,000*l*	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	101 —104	101 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3¼%	3¾%	3¼%	8⅛ — 8¼	8⅛ — 8¼	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5	...	13 — 13¼	13 — 13¼	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	...	6 %	... — ...	19/- to 20/-	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	17½%	36 — 40	36 — 40	39	...
150,000*l*	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...%	...	101 —104 xd	101 —104 xd	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	8 %	12 %	12 %	10 — 11	10 — 11	10 1/16	10⅝
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5½ — 6	5½ — 6	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	92 — 95	91 — 94	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, $\frac{1}{16}$—$\frac{3}{16}$
National Electric Free Wiring, 12/6 paid, $\frac{11}{16}$—$\frac{13}{16}$.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 15½—16½.
Do. do. Pref. (£10 pd.), 10—11.
*T. Parker, £10 (fully paid), 16½.

* From Birmingham Share List.

Bank rate of discount 3½ per cent. (June 6th, 1901).

MARKET QUOTATIONS, Wednesday, July 10th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	22/-	22/-	..
a „ Oxalic	per cwt.	32/-	32/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	39/-	39/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a „ „ ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£15	£15	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a „ (50/90%)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£23	£23	..
a Lead, Nitrate	per ton	£24	£24	..
a „ White Sugar	per ton	£31	£31	..
a „ Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	3½d.	3½d.	..
a „ Caustic (75/80%) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	61/-	61/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a „ Crystals	per ton	£3	£3	..
a Bichromate, casks ..	per lb.	2¾d.	2¾d.	..

METALS, &c.				
b Aluminium Wire, in ton lots..	per ton	£224	£224	..
b „ Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£75 to £140	£75 to £140	..
c Brass (rolled metal 2" to 12") basis	per lb.	7¾d.	7¾d.	..
c Tube (brazed)	per lb.	10d.	10d.	..
c „ „ (solid drawn) ..	per lb.	8½d.	8½d.	..
c „ Wire, basis	per lb.	8d.	8d.	..
c Copper Tubes (brazed) ..	per lb.	11d.	11d.	..
c „ „ (solid drawn) ..	per lb.	10¾d.	10¾d.	..
g Copper Bars (best selected) ..	per ton	£85	£85	..

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£85	£85	..
g „ Rod	per ton	£85	£85	..
e „ (Electrolytic) Bars ..	per ton	£82	£82	..
e „ „ Sheets ..	per ton	£90	£90	..
e „ „ Rod ..	per ton	£84	£84	..
e „ „ H.C. Wire	per lb.	9¾d.	9¾d.	..
f Ebonite Rod	per lb.	8/-	8/-	..
f „ Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	3/8 to 3/9	3/8 to 3/9	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants) ..	per ton	43 8	45/	1/4 dec.
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i „ Wire, galvanised No. 8 ..	per ton	£10	£10 5	5s. dec.
g Lead, English Ingot	per ton	£12 10 to £12 12 6	£12 12 6 to £12 15	dec.
g „ „ Sheet	per ton	£13 10	£13 10	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9 2 6	£9 2 6	..
d Mica (in original cases), small ..	per lb.	3d. to 9d.	3d. to 9d.	..
d „ „ „ medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large ..	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	1/0½ to 1/3	1/0½ to 1/3	..
p „ rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ „ strip & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	10½d. to 1/0½	10½d. to 1/0½	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15	to £40	..
i „ „ in bars		£58	£58	..
g Tin, block	per ton	£130 to £131	£132 to £133	dec.
g „ foil	per lb.	1/6	1/6	..
n „ wire, Nos. 1 to 16	per lb.	1/9	1/9	..
p White Anti-friction Metals — "White Ant" brand	per ton	£35 to £65	£35 to £65	..
j Yarns, Cotton, Single 10 lb. b'ndl's	per lb.	8½d.	8½d.	..
j „ Best Flax, 6 les.	per lb.	6d.	6d.	..
j „ Hemp, 3 ply 10 lbs. ..	per lb.	4¾d.	4¾d.	..
j „ „ Russian, 10 lbs. ..	per lb.	5¾d.	5¾d.	..
j „ Jute, 180 lbs. rove ..	per ton	£14 5	£14 5	..
k Zinc, Sh's. (Vielle Montagne bnd.)	per ton	£22 10	£22 10	..

Quotations supplied by { *a* Messrs. G. Boor & Co. *b* The British Aluminium Co., Ltd. *c* Messrs. Thos. Bolton & Sons. *d* Messrs. F. Wiggins & Sons. *e* Messrs. Frederick Smith & Co.

Quotations supplied by { *f* India-Rubber, G.-P. and Teleg. Works *g* Messrs. James & Shakspeare. [Co., Ltd. *h* Messrs. Jackson & Till. *i* Messrs. Bolling & Lowe. *j* Messrs. Henry C. Yoo & Co.

Quotations supplied by { *k* Messrs. Morris Ashby, Limited *m* Messrs. W. T. Glover & Co., Ltd. *n* Messrs. P. Ormiston & Sons. *o* Messrs. Johnson, Matthey & Co., Ltd. *p* The Phosphor Bronze Company Ltd.

* Subject to Founders Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.
Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.

INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION (GLASGOW CONVENTION).

COAL AND ASH CONVEYING GEAR.

By R. A. Chattock,
City Electrical Engineer, Bradford.

The question of dealing with coal used in electric generating stations is one of the most important that presents itself to the electrical engineer, and of almost as much importance is the question of disposing of the ashes that are produced by the boilers. Taking the average of a number of works the cost of the coal works out at ·71d. per unit, and this represents 46·6 per cent. of the average works cost per unit. In a station producing 5,000,000 units per annum this means an expenditure of £14,791 per annum, or, at an average rate of 12s. per ton, a consumption of 24,652 tons per annum. The cost of conveying and handling this coal varies between very wide limits, according to the distance it has to be taken, the height to which it has to be raised, and the means at disposal. As a rule coal contracts are drawn up to include the cost of cartage into the generating station, and it is consequently somewhat difficult to give an exact figure for this item. A charge of 6d. per ton for cartage from an ordinary railway siding for a distance of half a mile is, however, a fair estimate. This represents an annual cost of about £616 on the above quantity of coal.

If it is possible to put in a conveying apparatus that will take the coal direct from a railway or water siding and deliver it to the generating station, and if the annual charge on this, represented by, say, 10 per cent. on the prime cost of the apparatus, does not exceed the above amount, it is certainly worth while to adopt this principle. If, however, the distance is great between the siding and the station, and the cost of the apparatus excessive, it is better to have the coal carted to the generating station and distributed in the coal bunkers by means of a local conveying apparatus.

Horse traction for cartage purposes is a very unreliable means, especially in winter time when the frost is on the ground and when it is very important that there should be no interference with deliveries, and on this account, and also that the cartage may be under the direct control of the station engineer, a more reliable means should be provided. This may be effected by means of motor-driven trolleys, each capable of holding about 5 tons, so constructed that they can be backed under the coal drops of a railway siding or under the cranes used to unload a barge, and arranged so that they can be tipped into convenient hoppers in the generating station. Such vehicles can travel at a speed of eight miles an hour, and when not used for coaling purposes they can be utilised for conveying cable drums or other heavy gear about the town. They should be preferably steam-driven, and can be purchased for £500 or £600 each.

Once the coal has reached the station, the question of the most convenient means of storage presents itself to the engineer. The minimum amount which should be stored in a station is 100 tons for every 1,000 I.H.P. installed, and this amount can be conveniently contained in overhead bunkers placed above the boilers. It is, however, desirable to store four or five times this amount if possible, and to effect this an auxiliary coal store is necessary. This must obviously be placed outside the boiler house. It should be near the ground level and connected to the overhead store by means of conveying and elevating machinery.

The coal store or bunkers, whether overhead or on the ground level, may be constructed of brick or ironwork. The flooring should be sloped at an angle of 45° to points in the centre, from which distributing shoots can be taken either to supply the boilers or the conveying apparatus. The maximum depth of the coal stored in such bunkers should not exceed 10 ft. If this is exceeded the coal is liable to become overheated and to catch fire.

The construction of the bunkers, including the roof-work, should be entirely of non-combustible material, and fire hydrants should be placed in accessible positions. In an auxiliary coal store it is usual to have a conveyer running over the top of the store and returning underneath it. By means of this the coal can be collected from the points where it is discharged from the carts, and can be distributed in the store. If it is desired to draw coal from this store, the return half of the conveyer, which runs beneath it, can then be fed by shoots, and arranged so that it will deliver to an elevating apparatus. The elevating apparatus should take the coal to the level of the coal bunkers over the boilers, and it should be possible to feed this either from the auxiliary coal store or direct from the carts. After the coal has been elevated to the desired height it can then be distributed in the overhead bunkers by means of another conveying apparatus, and from these bunkers it should be fed to the boilers through shoots, which should be fitted with controlling valves.

There are many forms of conveying apparatus, and I will endeavour to describe those most in use, and point out their advantages and defects.

The worm type of conveyer consists of a worm or screw, which revolves in a semi-circular trough. The coal is fed into one end of this trough, and is gradually pushed along by means of the worm; it is allowed to fall through doors in the bottom of the trough, which can be opened when necessary. This apparatus can only deal with small coal, and it is very liable to get out of order, owing to lumps of coal becoming jammed between the worm and the trough. The power taken by this apparatus is also excessive, owing to the friction between the worm and the coal, and between the coal and the sides of the trough.

The chain type of conveyer consists of a chain formed of lines of bar-iron rivetted together; this is dragged along a flat-bottomed trough having doors on the underside; the chain passes over a sprocket wheel which is driven by gearing, and is dragged along the trough, pulling the coal with it. This conveyer is less liable to get out of order than the worm conveyer, but the friction between the chain and the trough, and the coal and the trough, is excessive. Another objection that this conveyer has is the fact that the rivets in the chain, which forms the pins on which the links turn, are buried in the coal, and in time these and the holes in the links become worn and cut away; the centres of the links consequently become elongated, and the chain does not gear properly with the sprocket wheel. The life of such a chain is not more than from three to four years.

The push-plate type of conveyer was devised with the idea of keeping the chain itself out of the coal. The chain of this conveyer runs on rollers above the trough, and attached to it are a series of rectangular plates which dip down into the trough and push the coal along as the chain is dragged forward. This is a better form of conveyer than the last, but it has the same objection owing to the excessive power absorbed in the friction of the coal when being dragged along the trough.

The band type of conveyer consists of a broad endless india-rubber or fibre belt, from 18 in. to 24 in. in width, running over pulleys at either end, and supported by rollers throughout its length. These rollers are shaped or inclined so as to cause the belt to sag in the centre and so prevent the coal from falling off. In order to discharge the coal from the belt, the latter can be tipped on one side at any desired point, and the coal will fall off the other side, or the coal may be scraped off by an inclined scraper placed at any point. This form of conveyer takes less power to drive, and there is no power absorbed in friction as described in the previous types. This type of conveyer has the advantage of being about the cheapest in first cost, and rubber belts such as these have been known to last from 10 to 12 years, and even then to be in a very fair condition. The working parts of the apparatus can be lubricated, preferably by means of grease.

The steel trough conveyer is composed of a number of steel plates, which are usually turned up at the edges, and which are fixed to the links of an endless chain. The chain may be run on rollers or may be fitted with small flanged wheels, which run on a tramway. The plates are so arranged that when the chain is approximately in a straight line they form a continuous trough, which travels along. The coal, which may be of any size, is fed on to this trough and carried along by it to any desired point, where it can be discharged. It has the advantage that the working parts of the chain are kept away from the coal dust, and there is no power absorbed in friction, the coal being carried along bodily. The conveyer is not, however, adapted for the convenient discharge of the coal at any point along its route. The return chain also is useless.

All the above types of conveyers can only be used for conveying coal approximately horizontally, and if used for elevating they should not be run at a greater angle than 30° with the horizontal.

Another type of conveyer that is being extensively adopted now is one in which the coal is conveyed by means of buckets which are hung on an endless chain. These buckets always hang vertically, and in this way the conveyer can be used either for conveying horizontally or elevating vertically, or at any desired angle. The chain itself is fitted with small flanged wheels, which run on an ordinary tramway composed of T section rails. Where it is necessary to change the direction of the motion from conveying horizontally to elevating vertically, curved rails are fitted to effect this. The chain is a double-link chain on each side of the buckets, and the driving is effected by means of toothed wheels or pawls, which engage with distance blocks fixed between the double links. This conveyer can only run in a straight line when moving horizontally, but the direction of the motion may be changed to one at right angles if desired, where the chain is ascending or descending vertically, by allowing the chain to twist where it is hanging free. The buckets are filled by means of funnel-shaped spouts which fit into them as they pass along, and each spout allows just sufficient coal to enter in order to fill the bucket. This conveyer takes very little power to drive it, as there is only the friction in the wheels to overcome and the dead weight of the coal to be raised. It is so free that the weight of the coal in the ascending buckets is enough to cause the chain to run backwards if the driving power is taken off, and means have to be taken to prevent this by using some form of ratchet and pawl. The working parts are protected from contact with the coal or ash dust, and in consequence have a maximum life. The buckets can be tipped at any desired point by means of a lever engaging with a pin on the side of the bucket. This conveyer can be used both for coal and ashes if it is arranged to travel over the coal bunkers and under the ash pits of the boilers, and in this way the cost of installing two conveyers and special elevating gear is obviated.

Another type of conveyer and elevator that may be employed is as follows:—

A long girder of H section is supported at any desired height by means of lattice framework and tie rods. On this is fitted a trolley which can be pulled backwards and forwards by a wire rope; on this rope is a pulley with a hook attached, and at certain points this hook can be lowered to the ground level, where a skip, holding about a ton of coal, can be attached to it. The skip is then raised, and when the hook is brought to the level of the girder it is gripped by the trolley, and the whole is travelled along; the skip can then be tipped at any desired point. The motion is then reversed, the skip brought back again, lowered, unhooked, and a fresh skip attached. In this method it is necessary to fill the skips by hand; they can, however, be emptied at any desired point. The working parts are kept free from coal and ash dust, and the apparatus does not take an excessive amount of power to drive.

Turning now to elevators as distinct from conveyers. The most usual type adopted is that having an endless chain, which passes over

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pulleys at the higher and lower level, and has buckets fixed to it. These buckets dig into the coal at the bottom end, in what is called the boot of the elevator; they carry the coal to the top, and as they turn over the top pulley they discharge the coal down a shoot, which, as a rule, feeds on to a conveyer. This form of elevator takes a considerable amount of power to drive it, and it has the disadvantage that the working parts of the chain come into contact with the coal or ash dust, and in consequence wear takes place.

For unloading coal from a barge the best form of elevator is an automatic grab which can be attached to a crane. This, while open, can be dropped into the coal, and, as soon as the lifting chain begins to pull, the grab closes, digs into the coal, and fills itself. It can then be lifted to any desired height, and discharged into a hopper, from which the coal can be taken by the conveyer. If desired, each grab can be weighed, and an automatic register kept of the weight.

Conveying and elevating apparatus is peculiarly liable to breakdown, owing to the rough nature of the work it has to do, and in order to guard against the serious results which a breakdown may entail during the heavy winter loads, some duplicate means should be provided for getting coal into the station and for getting the ashes away from it. Owing to the high initial cost of good conveying plant, it is not advisable to instal this in duplicate, unless the station be very large and the outlay be warranted. It would appear best to use some simple and effective means, such as a system of light tipping trucks, which can be run on a tramway in the boiler house, and which can be filled by hand. Such an arrangement, of course, entails a considerable amount of labour, but, being only a stand-by, and to be used only in an emergency, this item cannot amount to very much. In some cases means may be provided for taking the coal carts themselves into the boiler house and dumping the coal on to the floor.

With reference to ash conveying, the same type of apparatus can be used as is employed for coal conveying.

The ashes should not be allowed to interfere with the handling of the coal in any way, and should, if possible, be dealt with in a cellar below the boiler house flooring. In a boiler house containing a large number of boilers, if the ashes are allowed to accumulate even for a couple of days, the whole place becomes so choked, that it is impossible to work the boilers properly, and if there is a large space available below the floor, the ashes can be allowed to accumulate here for several days if it is impossible to get rid of them. The ashes should be taken to an overhead bunker, preferably at the end of the boiler house furthest from that at which the coal enters, and from this bunker they may be fed into carts or trucks by means of shoots. It is most essential that they should not be allowed to accumulate, and it is quite as important to provide duplicate means for getting rid of them, as it is for getting the coal into the station.

CASSEL'S CONSTANT SPEED WATER-WHEELS.

The want of a self-contained, simple, and absolutely reliable water motor has hitherto much restricted the application of the energy of water falling from a considerable height to the production and distribution of power. Various forms of impulse water wheels designed especially for modern high pressure systems have been put upon the market, each one claiming some peculiar advantage in respect of *efficiency*. No manufacturer, however, has attempted to put forward any claim to *self-regulation*, although this is admittedly an essential condition for any considerable development of this branch of hydraulic engineering.

The Cassel Self-Regulating Water Wheels, Limited, are introducing a form of impulse wheel in which reliable self-regulation of speed under varying loads and heads of water is achieved for the first time, and, as will be seen from an inspection of the illustrations which we publish, the value of this invention is further enhanced by the fact that it is not confined to any particular design of wheel, but it is applicable to all the best known types.

Wherever water power exists naturally it is used in spite of existing difficulties where possible for the production of power, because it is the cheapest natural source of power. Could it be controlled to the same extent and with the same reliability as steam, it would have absolutely no competitor in its field.

In Sweden and Norway, Scotland, Germany, Austria, Switzerland and Italy, there would appear to be at the present time over 3,000,000 H.P. of natural water power in use, and in the greater portion of these installations the conditions are those to which Mr. Cassel's invention is peculiarly applicable. The water horse-power at present running to waste, owing to the fact that no simple form of water-wheel has hitherto existed that would work reliably and without attention under variations of head and load, must run into tens of millions.

Figs. 1 and 2 are photographs of the wheel with buckets in a position of normal speed at full load and when governing.

Figs. 3 and 4 represent a sectional elevation of one form of the Cassel wheel with buckets closed and open.

Fig. 5 shows the wheel complete and ready for connecting with the pipe line.

When the wheel is at rest (figs. 1 and 3) it has every appearance of an ordinary impulse water-wheel, the two single buckets being of such a shape that when brought together they form the commonly adopted type of bucket with central rib for dividing the jet. Between the two discs carrying the halves of the buckets two T levers are provided. These levers are pivoted on pins fixed in the spider, which is keyed on to the shaft. At the end of the long arm of the T levers are mounted suitable weights.

The governing action is as follows: When the speed of the wheel reaches that for which it is designed, the centrifugal force exerted by the weights produces a pressure upon the discs tending to separate them, which is equal to the action of the springs tending to hold the discs together. Should the speed from any cause become greater than this critical speed, it follows that the force produced by the centrifugal action of the weights will become greater than that of the springs holding the discs together, and as a

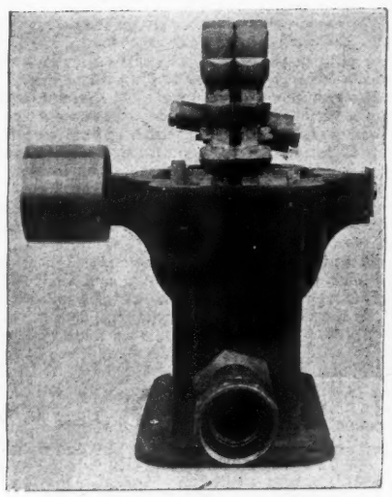

Fig. 1.

consequence the discs will be forced apart. In practice the actual increase of speed necessary to force the section apart is found to be very slight. The result of this is to separate the buckets and leave a space between them through which a section of the jet passes without exerting any impulsive effort upon the wheel. It is easily seen that the degree to which the discs are separated will be proportional to the area of the jet which is necessary to be utilised under any particular condition of load in order to maintain the speed at that for which the wheel is designed.

The position of the buckets in figs. 2 and 4 only obtains as long as the flow of water is in excess of that required to drive the wheel at normal speed for any given load. This characteristic enables the excess flow to be reduced as slowly as may be necessary to avoid all shocks in the pipe line. In proportion as the flow of water is

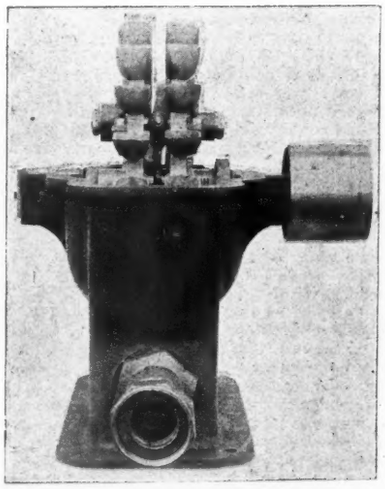

Fig. 2.

reduced the buckets approach each other again until they reach their original normal position, namely, close together—at normal speed. The full efficiency at normal speed for any load is thereby ensured. It is needless to point out that under these conditions the highest economy in water consumption is effected

We had an opportunity of examining the operation of this wheel at the offices of Mr. Ed. C. de Segundo, the company's consulting engineer. The wheel was worked by water pressure derived from the mains of the London Hydraulic Power Company, and the pressure at the nozzle was regulated by means of a stop valve. The pressure gauge fitted on the occasion of our visit did not register

higher than 400 lbs. per square inch, but the experiments which were made in our presence were sufficient to demonstrate the exceptional precision of the self-regulating action of this wheel At a pressure of about 40 lbs. per square inch, the tachometer registered about 450 revolutions per minute, which was very nearly the critical speed of the wheel. On the pressure at the nozzle being increased gradually from 40 lbs. to 400 lbs. per square inch, the

FIG. 5.

tachometer showed no appreciable variation in the speed. On the pressure being increased or decreased suddenly, the tachometer showed a momentary variation of speed, but this adjusted itself to the normal speed after a very short interval, perhaps five or ten seconds.

We give below an extract from a series of exhaustive tests made upon this wheel under considerable variations of load by Mr. E. B. Hussey, at Everett, Washington, U.S.A., on November 11th, 1900, at the pumping station of the Everett Water Works:—

"Speed test of Elmer F. Cassel's automatic hydraulic motor as made at Everett, Washington, November 11th, 1900, at the pumping station of the Everett Water Works:—Diameter of wheel, 18 in.; diameter of nozzle, §-in.; diameter of pipe, 2 in.; diameter of drive pulley, 18 in.; diameter of driven pulley on dynamo, 5 in. Water pressure approximately 105 lbs. by gauge, but this pressure varied from 100 to 110 lbs. according to pump pulsations.

	Revs. per minute of motor.		
No load	595		
No load to ⅛th load ...	570 ...	4·2 per cent.	decrease
⅛th „ ¼th „ ...	585 ...	2·6 „	increase
¼th „ ⅜th „ ...	575 ...	1·7 „	decrease
⅜th „ ½th „ ...	570 ...	8 „	„
½th „ full „ ...	550 ...	3·3 „	„
Full „ ½th „ ...	575 ...	4·5 „	increase
½th „ ⅝th „ ...	575 ...	0 „	variation
⅝th „ ¾th „ ...	580 ...	8 „	increase
¾th „ ⅞th „ ...	580 ...	1·7 „	„
⅞th „ no „ ...	590 ...	0 „	variation
No „ full „ ...	555 ...	5·9 „	decrease
Full „ no „ ...	590 ..	6·4 „	increase
No „ full „ ...	555 ...	5·9 „	decrease

"Resulting in a mean variation of 2·9 per cent. The greatest variation is evident where the full load to no load, and no load to full load, was applied instantaneously.

"The motor being unbelted from dynamo, and running entirely free, ran at a speed of 600 revolutions per minute.

"(Signed) E. B. HUSSEY, C.E.

"Seattle, Washington,
"*November 17th*, 1900."

Mr. Cassel's invention constitutes a fundamental and most important departure in the design of water motors, in that the speed is kept constant owing to the method of construction of the wheel itself, and is not in any way dependent upon the control or variation of the volume of water flowing at any time. The value of this peculiar characteristic of the Cassel wheel in connection with the generation of electric energy for power transmission can be scarcely over-estimated. Whatever the variation in load, whatever the volume of water passing through the nozzle, and whatever the variation in pressure of head, the wheel cannot race.

The Cassel wheel therefore is peculiarly adapted for direct connection to any electric generator, and provided the minimum supply of water is sufficient to run the plant at the critical speed for which the wheel is designed, any variations of load or head will not affect the speed.

The Cassel wheel is being introduced by the Cassel Self-Regulating Water Wheels, Limited, 56, Broad Street Avenue, E.C., who have acquired the European patents, the American and Canadian patents being controlled by an American organisation.

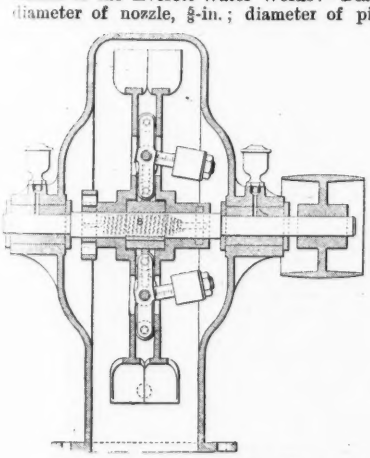

FIG. 3.—BUCKETS CLOSED UP.

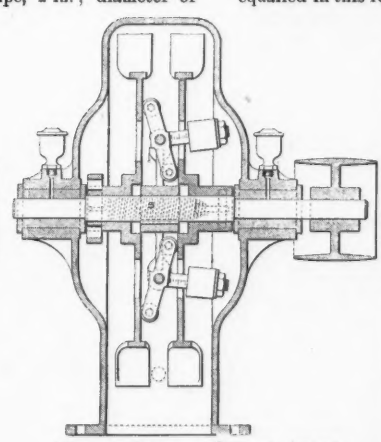

FIG. 4.—BUCKETS SPREAD APART.

IMPORTANT EUROPEAN ELECTRICAL AND ENGINEERING DEVELOPMENTS.*

BY WILLIAM J. HAMMER.

(*Continued from page* 12.)

THE NEW KÖRTING TWO-CYCLE GAS ENGINE.

The concern of Gebr. Körting, at Körtingsdorf, near Hanover, Germany, is now building engines of 1,000 H.P. and over of the 4-cylinder 4-cycle type, for use with high furnace gases for driving dynamos, air compressors, exhaust fans, &c. Körting's most interesting new type of 2-cycle gas engine, which I saw running in their works during my recent visit, consists of a single working cylinder, containing a driving piston, on each side of which the mixture of gas and air is alternately admitted, exploded, and does its work, reproducing steam engine conditions. Remarkable uniformity of speed is secured by this engine; in fact, it is doubtful if it is equalled in this respect by any other type of gas engine at present on the market. Exhaust ports are situated in the centre of the cylinder. The piston itself acts as a slide valve to open and close these ports, when it moves in the zones of the dead point at the end of each stroke. Although there is an explosion on each side of the piston, the temperature is kept very low by water-jacketting the cylinder and stuffing box and causing water to circulate through the piston itself. The working mixture is crompressed by the main piston on its return stoke to about 12 atmospheres, and when at its dead point exploded by two electrical igniters, one placed close to the piston and the other close to the inlet valve. On the side of the engine may be seen the gas and air pumps, which are relatively proportioned and connected together. The pumps are provided with piston valves which are operated by an eccentric on the main crankshaft, and serve to direct the gas and air first to one end and then to the other end of the cylinder, performing the same function that is fulfilled by the admission valve of a steam engine, the inlet valves on the ends of the cylinder being merely check valves to prevent back pressure from the cylinder into the pumps. The air and gas arrive, separated from each other, at the valve casing, where they are thoroughly mixed, and enter the cylinder. During about 40 per cent. of the stroke, the gas is caused to pass around a by-path, and none enters the working cylinder. During this 40 per cent. of the stroke, air alone is introduced in the cylinder, scouring out the products of combustion, which pass through the exhaust; it also forms a layer between the burnt gases and mixture, lowering temperature inside the cylinder, and making pre-ignition impossible.

One of the most important features in Mr. Körting's engine, and one which he claims it would be impossible to operate without, is a projection in the combustion chamber, below the inlet valve. This projection is almost semi-circular and of a special form which is the result of considerable experimentation. It is on the concave side of the combustion chamber, which causes half of the moving charge to

* Abstract of paper read by Mr. W. J. Hammer before the American Institute of Electrical Engineers, February 28th, 1901.

Between the two discs carrying the halves of the buckets two

pressure gauge fitted on the occasion of our visit did not register

become deviated at right angles to the rest of it, thus producing a whirling and rolling motion. This materially assists the scouring action of the air and assists also the thorough mixing of the air and gas, which mixture thus loses all tendency to force itself in the form of jets, into the dead mass of burnt charge and air ahead of it, which it would ordinarily mix with, and cause considerable loss of the new mixture, by its passing out through the exhaust. Were this effect not produced, the loss of gas escaping through the exhaust ports would be so great as to make the engine, as built, uncommercial. The regulation of the engine is secured by the governor acting on the slide of a link motion, which acts on the distribution slide of the gas pump, and according to the position of the slide of the link, the rate of circulation in the gas pump is increased or decreased, controlling the quantity delivered at each stroke. The quality of the mixture remains the same. Mr. Ernst Körting informed the writer that this engine could be built with 25 per cent. less lbs. of material than any gas engine of the same horse-power in the market and at a manufacturing cost per lb. not exceeding other types.

The Oechelheuser Gas Engine.

This engine is one of a number of important types of gas engines of large power, which have developed since the sudden demand caused by the utilisation of "high furnace" gases for gas engine driving. This engine has but one complete cycle per revolution. It has one long horizontal water-cooled cylinder, containing two pistons, which between them perform the functions of admission and compression of the charging mixtures and the discharge of the products of combustion or exhaust gases. The engine has no valves or cam-shafts. The front piston is connected to the centre of a three-throw crank and the rear piston to the two outer cranks. These cranks are 180° apart. The cross-head of the back piston is also attached to the piston-rod of a double-acting pump, which compresses the gas and air mixture on one side of its piston and air alone on the other side. As the two engine pistons approach in the cylinder, the mixture is compressed between them to a pressure of from 1 to 10 atmospheres and exploded electrically. The pistons are thus driven apart, each doing its work upon the main shaft. Before the completion of the full stroke the front piston uncovers the annular exhaust port, permitting the discharge of the exhaust gases. The rear piston at the end of its stroke uncovers first a port admitting air under slight pressure, to scour out the remaining products of combustion, and then a second port, through which the previously compressed explosive mixture from the pump is admitted. The exhaust port remains uncovered while the mixture pushes out the scavenging air, and then the pistons close all the ports on the return stroke. Compression then follows, and the cycle is repeated. It is claimed that none of the fresh charge escapes through the exhaust, as the cylinder is so proportioned, that even when running at maximum load, the charge occupies but 70 per cent. For slight variations in speed the governor controls the proportions of mixture of gas and air. For wider limits it regulates the quantity of charge through the mixing valve cock and the return slide valve. Part of the compressed charge passes into the suction pipe, and is then transferred to the other side of the pump, instead of to the motor cylinder, as usual. Admission and exhaust are effected in one stroke instead of two. The cylinder dimensions are smaller for the same power than in the four-cycle type of engine, as one explosion is obtained at each revolution, and as this is effected by two working pistons, acting on the same shaft, the power is said to be increased fourfold. The turning moment on the main shaft is produced by a couple, and the unbalanced forces transmitted to the bed-plate are much less than ordinary. Great regularity is obtained by the impulse at each revolution, and rapid expansion follows each explosion. The engine is, however, of considerable length, and the extra cost and complication of the three cranks, three connecting-rods and two cross-heads, rods, pump and pump-gear are to be taken into consideration. In the latest designs the pump is placed below the floor and under the engine, making a very compact arrangement. The Kraft Gas Gesellschaft, of Berlin, which is now manufacturing this engine at Aschersleben, is turning out a large number of these engines, up to 2,000 B.H.P., in the twin arrangement, for driving electrical machinery, fans, air-compressors, &c.

(To be continued.)

PHYSICAL SOCIETY.

Ordinary Meeting held by Invitation of Prof. W. G. Adams in the Wheatstone Laboratory, King's College, June 28th, 1901.

Prof. Everett, F.R.S., Vice-President, in the Chair.

A Paper on "The Effect of a High Frequency Oscillatory Field on Electrical Resistance," was read by Mr. S. A. F. White.

The object of this paper is to discover if the action of light upon the electrical resistance of selenium can be imitated by using high frequency electrical oscillations. It is found that such oscillations permanently increase the resistance of selenium. The effect of a rise of temperature is to increase the resistance of a piece of low resistance, and decrease the resistance of a piece of high resistance. The effects of the field in a piece of high resistance can be reversed by exposure to light, or by reheating and subsequent cooling. In the case of tellurium a high frequency field temporarily decreases the resistance, as also does a rise in temperature. Repeated heating and cooling of a piece of tellurium permanently increases its resistance. It seems probable that all of the effects are due to rise of temperature caused by minute sparks within the mass. The rise in resistance by alternate heating and cooling may be due to the formation of tellurides with the metal of the electrodes. The large negative temperature effect of tellurium suggests that it might be usefully employed in the detection of heat radiation.

The Chairman expressed his interest in the paper, and drew attention to the very rapid action of light upon selenium.

Prof. Adams said that as the effects here noticed were not so rapid as in the case of light they were probably due to change in temperature.

Prof. Bose said he had tried the effect of Hertzian radiation upon thin layers of various metals, and found an increase of resistance in the case of selenium and a decrease in the case of tellurium. The effect of radiation is confined to a few layers on the surface of the conductor, but it appears that it is of the same nature in continuous solids as in coherers.

A Paper by Mr. E. C. C. Baly and Dr. H. W. Syers on "The Spectrum of Cyanogen," was read by Mr. Baly.

The authors have been able to obtain the spectrum of cyanogen by allowing the pure gas to flow through a vacuum tube and observing from the end of the tube. This is necessary on account of the brown deposit of paracyanogen which renders observation in the ordinary way impossible. The spectrum obtained differs from the flame spectrum, and consists of a series of equidistant flutings through the whole of the red and yellow, somewhat recalling those of the positive band spectrum of nitrogen. The experiments prove that, first, the swan spectrum is not produced by a carbon compound which does not contain oxygen; second, the swan spectrum is that of an oxide of carbon, as it is only produced by carbon monoxide; and as this spectrum is changed at once into the carbon oxide spectrum by admission of oxygen or by intense electric discharge, and further, as the carbon oxide spectrum is invariably given by carbon dioxide, there can be no doubt that, third, the swan spectrum is that of carbon monoxide and the carbon oxide spectrum that of carbon dioxide.

Mr. Gaster said that this paper might throw light on the discussion of the arc where cyanogen, carbon monoxide and carbon dioxide are present. The presence of cyanogen might be able to explain the hissing of the arc.

The Society then adjourned until next October.

CURRENT SPECIFICATIONS.

LXX.—BIRKENHEAD ELECTRIC TRAMCARS.

Summary.

Extent of Contract.—Supply and delivery of 15 electrically-equipped tramcars.

Division of Contract.—Separate offers to be sent in for car bodies, trucks and electrical equipments.

Car.—To be of double-deck type, suitable for mounting upon bogie trucks. To be suitable for seating 66 passengers, 30 inside and 36 outside.

Gauge of Line.—4 ft. 8½ in.

Trucks.—Each car to be equipped with two equal wheel bogie trucks arranged to support one motor on each axle, or four motors per car. Diameter of axles, 3¾ in.; diameter of wheels, 30 in.; wheel base, 4 ft. to 4 ft. 6 in. Ten years' warranty to be given with all parts except springs, wheels and brake-shoes.

Trolley Pole.—To be of the swivelling arm type, enclosed springs to be optional with tenderers.

Motors.—Each car to have four motors rated as 20 H.P. size, and wound for 500 volts.

Ratio of Reduction Gear.—Not to exceed 4·8 to 1·0; width of gearing not to be less than 4½ in.

Test for Motors.—The four motors to be able to propel a fully loaded car, having a total weight of 12 tons, at a speed of 10 miles per hour up a gradient of 8 per cent., the track being in fair condition.

Flashing Test for Motors.—2,500 volts maintained for five minutes between every part through which the current flows and frame.

Type of Controllers.—To be suitable for working with pairs of motors, and to have rheostatic brake. Fronts not to be fixed on hinges.

Type of Lightning Arrester.—To be of usual pattern, complete with reactance coil.

Date of Completion.—Seven complete cars by October 1st, 1901, the remaining eight by October 31st, 1901.

Penalty for Late Completion.—£1 per day for each car body, truck or equipment late, or £3 per complete car per day.

Terms of Payment.—During progress of the work up to 70 per cent. of value of materials and work delivered on site; 20 per cent. on satisfactory completion; the remaining 10 per cent. 12 months later. Car bodies, trucks and equipments to rank separately when calculating payments.

Period of Maintenance.—Twelve months from date of completion; see comments below.

Stipulations as to Removal of Foreman.—Satisfactory.

Stipulations as to Wages to be Paid to Workmen.—None.

Full	„	no	„	...	590	...	6·4	„	increase
No	„	full	„	...	555	...	5·9	„	decrease

* Abstract of paper read by Mr. W. J. Hammer before the American Institute of Electrical Engineers, February 28th, 1901.

Stipulations as to Sureties.—Two to be named with each offer, to be willing to be bound in the sum of £500 for the car body and truck sections, and £1,000 in the electrical equipment section.
Arbitration Proposals.—Unsatisfactory; see comments below.
Date for Receipt of Tenders.—July 16th, 1901.

These three specifications for the car bodies, trucks, and electrical equipments respectively of 15 tramcars, have been prepared by Mr. A. R. Fearnley, the tramways manager to the Birkenhead Corporation, the owners of the local tramway systems.

It will be noticed that the cars are to be of the double-deck type, each with two equal wheel bogie trucks, a four-motor equipment, and to have the controllers arranged for rheostatic brake. At the present time there is a great tendency in this country to adopt four-motor equipments whenever the demands of the service are specially severe. It is claimed by the advocates of this method of working that the economy in use more than compensates for the extra first cost, while there is considerable gain in the tractive force and the more even distribution of the weight of the equipment over the two trucks. It will be interesting to note whether under the conditions of British tramway service these claims can be substantiated, or whether better results cannot be obtained with a lower first outlay by an increase in the size and rating of the two-motor equipment.

The general conditions are in some directions exceptionally onerous, and to render them ordinary commercial risks, need some modification.

There is no provision for settlement of disputes by an independent arbitrator, the decision of the tramways manager being final and binding upon all parties. This we consider totally unfair. The person responsible to the purchasers for the due carrying out by the contractor of the terms of the contract ought not to be sole arbitrator. He is not only one of the parties to the dispute, but also a servant to one of the parties, and, therefore, in the opinion of the other party to the dispute he is unfitted to decide the case upon its merits. It is becoming more and more recognised that it is not fair to place anyone in such an invidious position as counsel to one side and sole judge of the case at the same time, and no doubt strong objection will be taken to this clause by tenderers.

The maintenance clause is also of a stringent nature. The period named is 12 months, but the contractor is to take the risk, and be responsible for all accidents and damages to persons or things within that period, unless he can prove to the tramways manager that the defect is not due to faulty material, construction, or workmanship. This we consider unfair. The contractor should be responsible for a given period for faults due to the defective workmanship or material, but the onus of proof that accidents are due to these causes should, in our opinion, be laid upon the user of the plant, not on the absent manufacturer. It is quite possible that a servant of the purchaser may endeavour to evade responsibility for the consequences of his own carelessness by attempting to throw the blame for an accident upon the contractor, and in the absence of any representative, it may be impossible to refute the charge. The clause should be amended in the direction of placing the onus of proof of responsibility upon the purchaser and user, the contractor simply being liable for faults proved to be due to faulty workmanship or material. It is not clear to what extent the demand for a 10 years' warranty for certain parts of the trucks is intended to modify or extend the 12 months' period of maintenance specified for each section.

The terms of payment are acceptable, the amounts for which security must be found are stated for each section, and we find the usual clauses *re* powers of purchaser over plant brought into his premises during the progress of the work, inspection of work during manufacture at contractors' works, &c. It will also be noted that the delivery dates are short.

THE ENGLISH MECHANIC.

From across the herring-pond a doleful plaint has reached our ears—mourning the rapidly approaching extinction of the "real" American mechanic. It is claimed by our country cousins that the active industrial situation now obtaining in their country is largely due to the existence of the American mechanic, and that the evolution of this highly specialised being has been brought about by the following means:—Special system of training; apprenticeship; direct instruction in the shops; free education; wages high enough for the enjoyment of culture. The problem put for solution is the best method of perpetuating this valuable species.

It is not for want of technical schools that the trouble arises—they are in abundance everywhere; but how to obtain shop experience before coming to the shop appears to be the gist of the lament—this, and the fact that the apprentice system is dying—for which it is held that trades unionism is chiefly responsible.

The need for good men daily increases, and although the introduction of automatic machinery has reduced the number of mechanics generally required, it is essential that this smaller number be of the highest ability.

The pessimistic writer of the article in question affirms that it would be a "crime" to let the American mechanic die; nevertheless, says he, extinction threatens, and the picture is indeed unpleasant. His sorrow extends to our shores, for he considers that the English mechanic is still further on the road to annihilation.

It is not for us to suggest remedies to our friends across the seas; it behoves us rather to turn attention to our own children. It may assist us, however, to refer briefly to the American mechanic and his evolution. Many have said, and the statement seems to be gaining credence, that the American artisan is far ahead of ours in ability, grit and output. We attribute the superiority, so far as it exists, principally to the following causes:—Dry bracing climate (there is far more in this than one would at first suppose).

The rapid growth of the country, which has attracted the best talent from all parts of the world.

The enormous expansion of the industry, which has made it absolutely necessary to get good men at any price—this has acted as a powerful stimulus to *make* good men where they could not be obtained ready made, and to this end masters and men have taken endless trouble to foster skill and intelligence by encouragement and prompt recognition of merit.

The fact that in the United States of America credentials are considered unnecessary—a man can walk into a shop, and however irregular or unconventional his training may have been, he is paid what he can earn. He takes off his coat and starts "right away," and is rated according to what he can do. There is no doubt that this custom of standing on one's own bottom has a wonderful effect in attracting good men (who are often those who have not had a regular or recognised course of training) and of eliminating wasters.

The good pay received by American artisans, which allows them opportunity of culture, and the feeling of self respect which has been fostered by attention to the question of personal comfort and convenience—such as the introduction of lavatories and dining rooms.

The scope of this article does not allow the enumeration of further causes contributing to the superiority of the American mechanic, but it may be said generally that his employer is much more go-ahead than his self-satisfied cousin. On the other hand, we do not think he is any cleverer or sounder in his ideas than the Englishman—the great difference being that whilst both have good ideas, the former puts his into operation as soon as they are conceived, whilst the latter ponders and re-ponders, in case something better should present itself, or until someone else has tried and approved the idea in question.

The American manufacturer is extremely bold and drastic in his policy, and will at any time tear existing things up by the roots provided he is reasonably satisfied that he can improve matters by so doing. In this way he is always a phase ahead of his more cautious European rival.

This fearless and go-ahead example is bound to have its influence upon the mechanic within its range, and is no small item in his evolution.

It is satisfactory to know that the English mechanic can hold his own among his American fellows when once he gets to their country. We have come across an English erector in the States who was earning £500 a year.

resistance, and decrease the resistance of a piece of high resistance. The effects of the field in a piece of high resistance can be reversed by exposure to light, or by reheating and subsequent cooling. In

see comments below.

Stipulations as to Removal of Foreman.—Satisfactory.

Stipulations as to Wages to be Paid to Workmen.—None.

Having endeavoured to show the factors that have operated in the production of good mechanics in the States, let us profit by the warning note and consider what steps we should take to perpetuate our better class of mechanic and improve his species.

To make good men there is no royal road. The cardinal requisite in this, as in the inanimate branch of manufacture, is to start with good material—bricks cannot be made without straw. Our suggestion for obtaining sound material is to draw lads from a respectable class of life, giving the preference to those that have done well at school. Having made the selection, the lads should be taken for one month's approbation and not actually bound till after a further five months' trial.

From the cream of this category we would institute a class of "special apprentice," and give him advantages in the way of special training, passing him through more than one shop, according to requirements, and, above all, he should have at least six months in the drawing office. His position would be between the ordinary apprentice who learns one branch of the trade and the premium pupil who "smatters" in them all. With the latter it could be worked so as to avoid clashing and the feeling of unfairness.

One or more of this class would be created each year, the selection being made entirely on the question of merit. This method of choice would doubtless lead to more or less heart-burning, but would be an excellent incentive to employés to put forth their best efforts in their struggle for the privilege, and would attract sons of respectable parents to join the firm on the chance of selection.

The details of training would not be on hard-and-fast lines, but would be determined in harmony with the ultimate object in view; but in all cases attendance at certain evening classes should be a *sine quâ non* of the privilege bestowed upon "specials."

A certain amount of out-door work is strongly recommended, even if the mechanic is being "manufactured" for indoor use. It is one of the surest ways of giving grit and encouraging the spirit of self-reliance and resource.

With regard to the drawing office, to which allusion has been made, the accommodation of this department is frequently so limited that it would be impossible to pass all specials through it; in such cases it would be well to select one youth annually—a still further step in eliciting the best ability.

There are a number of other factors in the training of these apprentices that need not be mentioned here, and we will pass on to a few thoughts regarding the treatment of the fully-fledged "special" and "ordinary" mechanics.

There are few employers so philanthropic or trusting that they would care to go to the trouble and expense of affording a special training, with the chance of losing the subject of their enterprise at the age of 21, just when he would be beginning to be useful.

It is quite recognised that there are some sufficiently grateful (and far seeing) who would be willing to render their *quid pro quo* by continuing with their trainers for four or five years at ordinary shop rates, but the temptation to rise rapidly that their special training would present, would in many cases, it is feared, prove too great.

The suggested way of meeting this difficulty is to bind till the age of 21, with the employer's option of extension to 25, at a certain progressive wage, and with a further proviso that from that age to 30, the original employer would have the right of retaining the special at whatever rate he could command in the open market.

To revert to the question of the best method of treating the mechanic after he has reached 21 (the first stage of his bond), and of mechanics trained in the ordinary way, we would say: Treat them as self-respecting human beings and provide for them facilities for washing and for eating their mid-day meal. Adopt the single-break day (the later hours of starting work affording an opportunity of attending evening classes and self-improvement without encroaching upon sleep). Provide a good library of technical books, and a reading room, where the current numbers of British and American journals may be perused.

Inaugurate an engineering society on free and easy lines, making it attractive and not too formidable, so as to encourage a good attendance and contributions from junior members. An institution of this character, properly worked and personally attended by the principals, does much to raise increased interest in the profession and is the means of eliciting the talent that lies dormant in every shop. It is a good plan to offer two or more premiums during the session for the best paper among different classes of artisans, the award being made by general vote of those actually attending the meetings.

Whilst providing various channels for mental stimulus and elevation, the physical side of the question must have its share of attention in the shape of football, cricket, cycling, rowing and swimming clubs.

In very large establishments it might be found profitable to appoint an expert who would spend all his time in showing the very best way of carrying out the various operations upon the most scientific and expeditious lines, and who would be able to devote more time to individuals than would the foreman.

There is an important condition in the training of good men that should not be overlooked, namely, the enlarging of their horizon and opening of their minds, by letting them see other shops, and we think that two or three visits a year of the most promising men and lads to shops having good methods would be money well spent.

When you have made your mechanic, or found him ready-made, do all that you can to make him comfortable, and fix no arbitrary limit to the wages that any man can earn, regardless of wage or operation. Directly a man has reached his money-earning limit, he is inclined to discontinue or reduce his effort.

Your only consideration should be whether it pays to give the higher rate. Thus, if a man at £5 a week can produce more cheaply than his fellow at £2, pay him this amount regardless of the standard rate for his occupation.

The question of one man working more than one machine might be discussed, but the aim of this article is to consider the training of mechanics rather than the methods of producing maximum shop output.

Having considered the general lines recommended for the cultivation and perpetuation of the English mechanic, we should like to say, in regard to our contemporary's allusion to the suppression of the apprentice system by trades unions, that the best cure is federation.

COAL AND ASH CONVEYING GEAR.

The paper read by Mr. R. A. Chattock at the recent Convention of the Incorporated Municipal Electrical Association, on "Coal and Ash Conveying Gear," deals with one of the details of central station work which is of very considerable importance. Coal must always form the main factor in the running expenses of a steam-driven generating station, and with the advent of electric traction its relative importance is greatly augmented.

We are not quite clear as to what the author has in mind as the proper sphere for conveying plant. He says that, as a rule, coal contracts are drawn up to include the cost of cartage into the generating station, and he then goes on to estimate the cost of this cartage from a railway siding half a mile distant. The figure so arrived at he compares with 10 per cent. of the cost of a conveying apparatus to do the same work. We do not know of any cases in which conveyers in the ordinary sense of the term have been put in for such long distances, and except in the open country the difficulties in arranging for them, quite apart from their prohibitive cost, would probably be insuperable.

Large stations should always be provided where either railway or water communication is available; handling by ordinary carts of such large quantities as 25,000 tons of coal per annum being altogether unsuitable, apart from the question of cost. This the author recognises, and he recommends the substitution of motor-driven trolleys, each holding 5 tons, for ordinary carts. It would be interesting to know how such a scheme would work, but we fancy that most engineers would greatly prefer to have a siding. It is in taking the coal from this siding or from the wharf to the boilers or the coal store that conveyers find their proper sphere.

From across the herring-pond a doleful plaint has reached our ears—mourning the rapidly approaching extinction of the hold his own among his American fellows when once he gets to their country. We have come across an English erector in the States who was earning £500 a year.

The question of storage is next touched on by the author, and he lays down the minimum amount that should be stored as 100 tons for every 1,000 I.H.P. installed. Several speakers in the discussion on the paper referred to this point, and there seemed to be a general consensus of opinion that the figure suggested was a very modest one, as it certainly is. The quantity named will suffice to provide for such contingencies as a breakdown in the conveying gear or some accidental interruption in the ordinary supply of coal, but it would be absolutely useless in the case of a coal strike or any prolonged withholding of fuel.

The whole question of coal storage is a very difficult one, and depends greatly upon local conditions. The general principle may be laid down that the more coal that can be stored the better, up to, say, three months' supply. The ruling consideration, however, will be the question of cost, the damage ensuing from a stoppage of supply being set against the cost of the land and structures necessary for storing the coal. In those cases in which the generating station is situated where land is dear, it may pay to have a store at some considerable distance away where plenty of land can be had at a low price. It is true this involves double handling, but in any case where the reserve is large an auxiliary store has to be resorted to.

In considering the store itself, the author recommends that the flooring should be sloped at an angle of 45°. One of the speakers in the discussion thought this angle should be greater and another less. In our opinion, it is better to err on the side of too sharp a slope, for when coal is wet the ordinary angle of repose is greatly exceeded, wet slack sometimes attaining even 90°. Where this last named material has to be dealt with, mechanical agitation must be provided for, otherwise the material may arch over the shoots and entirely stop the supply.

The author recommends that the maximum depth of the coal in the store should not exceed 10 ft. in order to avoid heating. More emphasis might have been laid on the danger of spontaneous combustion, which is a very real one in the case of large quantities of coal. It is important that the coal should be dry when put into the store, and that the store should be protected from the weather. Fine coal or dust is peculiarly liable to ignition, and for this reason the coal should be in large pieces and breakage in handling it be avoided. The bunker should be split up so as to isolate any portion which may take fire, and an air space should be left between the divisions in order to keep the coal cool. Good ventilation of the bunkers is also essential to remove any gases given off. It is important also to thoroughly clear out the bunkers as frequently as possible, so as to avoid the presence of very stale coal.

The deterioriation of coal with storing is not touched on by the author, but several speakers called attention to it. Considerable diversity of opinion existed. Mr. Newington, of Edinburgh, stated that he had found no difference in Scotch coal after storing for a considerable time, but he was unable to give any tests of calorific value in support of his statement, while several speakers testified to the great deterioration of Welsh coal with lapse of time. It is usually thought that coal deteriorates very much through storage, and this is a consideration to reckon with in determining the amount which undertakers can afford to hold in reserve. It is worth pointing out that briquettes are found not to be liable to spontaneous combustion, and presumably they would deteriorate but little with keeping. They are, therefore, a class of fuel to which central station engineers might direct their attention.

Mr. Chattock proceeds to describe the principal types of conveyer in use, commenting upon each in turn. He omits to point out one substantial drawback to the Worm type, namely, that it grinds the coal, thus producing a considerable quantity of dust. An advantage of the Push-plate type might have been pointed out, namely, that it can be employed to fill a long bunker without any attention whatever at the delivery end, by the simple expedient of having a series of apertures at the bottom of the trough, which are closed in succession by the coal itself as the bunker fills up. The durability quoted by Mr. Chattock for the rubber belts used for the Band type of conveyer is very considerable, and must have made some of the engineers present wish that they could have got the same quality of rubber put on their cables. We think Mr. Chattock is mistaken with reference to the Gravity Bucket type, when he says it can only run in a straight line when moving horizontally. Some makes of this conveyer will go round a curve provided that its radius is not less than 15 feet.

Some reference might have been made to the distances to which the various types of conveyer are applicable. A single Worm cannot well be used for a greater length than 150 ft., while beyond 500 ft. practically the Gravity Bucket and Belt are the only two available.

After a short reference to elevators as distinguished from conveyers, the author touches on the desirability of duplication of plant. While emphasising the necessity for providing an alternative means of some kind for getting coal to the boilers, he considers a second conveyer too costly, and recommends some other form of standby even though it only be by means of carts.

The paper concludes with a short consideration of the conveyance of ashes, and the importance of not allowing them to accumulate is rightly insisted on.

Mr. Chattock's paper gives an excellent idea of the present state of coal-handling plant, and should be useful to central station engineers for reference.

In view of this paper, it was interesting to note the arrangements made at the Pinkston generating station, established in connection with the Glasgow tramways. Here a gravity-bucket conveyor was in operation, and its smooth and quiet working was very noticeable. Provision had been made by means of bunkers of enormous depth for the storage of very large quantities of coal. No precautions whatever had, however, been taken to avoid the danger of spontaneous combustion, and, in fact, this point appeared to have been entirely overlooked.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1901.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

12,815. "A Morse signalling lamp." G. J. Boyman. June 24th.

12,816. "Improvements in wireless telegraphy." H. Shoemaker. June 24th.

12,835. "Improvements in electric cranes, and other electric lifting appliances." Stothert & Pitt, Limited and P. K. Stothert. June 24th.

12,862. "Improvements in connection with electric cables or conductors where branch terminals are used, especially applicable to the wiring of electrically-driven vehicles." P. Dawson. June 24th. (Complete.)

12,870. "Improvements in and relating to trolleys employed in overhead wire systems of electric traction." E. M. Munro, H. Breckenell, and H. I. Rogers. June 25th.

12,896. "A device for use within electric ceiling roses and the like." W. G. Stones. June 25th. (Complete.)

12,947. "An improved electric telegraph code." H. H. Lake. (C. G. Burke, United States.) June 25th. (Complete.)

12,954. "Improvements in electrical secondary or storage batteries, or accumulators." W. Peto. (P. Gouin, France.) (Complete.)

12,974. "Apparatus for making secondary battery plates." A. F. Madden. (Date applied for under Patents, &c., Act, 1883, Section 103, March 19th, 1901, being date of application in United States.) June 25th. (Complete.)

12,975. "Secondary batteries." A. F. Madden. (Date applied for under Patents, &c., Act, Sec. 103, March 19th, 1901, being date of application in United States.) June 25th. (Complete.)

12,991. "Incandescent electric lamps." J. Swinburne. June 26th.

13,010. "An improved telephone and bell set." M. Byng and F. G. Bell. June 26th.

13,017. "Recording apparatus for electrical measuring instruments." A. Hill. June 26th.

13,021. "The improved combined automatic clutch for electric, arc, or other lamps, and safety hooking devices for rope suspension gear." G. J. Philpott and G. H. Alderton. June 26th.

13,032. "Improved process for the reduction of ores or compounds by means of the electric current." H. A. Irvine. June 26th. (Complete.)

13,033. "A polyphase electric motor." Siemens Bros. & Co., Limited, and F. Lydall. June 26th.

13,044. "A spark spreading device for lightning arresters of electrical conductors." H. A. Bertram. June 26th. (Complete.)

13,048. "Improvements in electrodes for accumulators." A. Tribelhorn. June 26th. (Complete.)

13,078. "Improvements in electric accumulators." G. J. Gibbs. June 27th.

13,129. "Improvements relating to electrical ignition devices for gas and similar engines." J. Hutchings. June 27th.

13,142. "Improvements in the construction of commutator trimming apparatus." J. Phillips. June 27th.

13,159. "Improvements in resistance switches and automatic cut-outs for starting, protecting, and regulating electric motors and their circuits." J. Edmondson. June 28th.

13,170. "Improvements in the brackets or guides of lightning conductors." J. Nichols, J. H. Nichols, and W. E. Nicholls. June 28th.

13,182. "Improvements in the manufacture of ornamental vases, bottles and other ornamental vessels, electric switch caps and other articles." H. Deacon, T. Birkett, and F. G. Faulkner. June 28th.

13,187. "Improvements in solutions to work electric and galvanic batteries." J. B. de Alzugaray. June 28th.

13,207. "An improvement in the manufacture of filaments for electrical glow lamps." H. C. Gover and A. C. Hyde. June 28th.

13,230. "Improvements in alternating current motors." C. Wust-Kunz. June 28th.

13,231. "Apparatus for generating and utilising electric energy." W. S. Simpson. June 28th.

13,247. "Improvements in and relating to switches for trolley wires or conductors of electric tramways or railways." W. H. Lamberton. June 29th.

13,256. "A new and improved process for transferring several telegrams in both directions by means of a single wire." R. Scharf. June 29th.

13,300. "Improvements relating to the manufacture of electrode plates of secondary electric batteries." A. Nodon. (Date applied for under Patents, &c., Act, 1883, Sec. 103, December 1st, 1900, being date of application in France.) June 2sth. (Complete.)

13,301. "Relating to steam engine telegraph and similar apparatus." E. Arfelt. June 29th. (Complete.)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester and Birmingham, price, post free, 9d. (in stamps).

1900.

20,877. "Improvements in the manufacture of opalescent surfaces for electric lamps or glass reflectors." The Improved Electric Glow Lamp Company, Limited, and A. Barnes. Dated October 18th, 1899. An opalescent or opaque reflecting-surface is produced on glass by coating it with a creamy mixture of zinc oxide or barium sulphate, opal glass, silica and cryolite, all finely powdered, with solution of potassium or sodium silicate; pigments may be added. When dry, a thin coating of hot paraffin wax, or gelatine and gormalin, may be applied. Electric lamp bulbs, lamp globes, glass reflectors, and other glass may be thus treated, by dipping, or with brushes, pads or rollers. 2 claims.

20,882. "Improved sliding contacts for telescopic or similar adjustable electroliers." M. Wiedlick and K. Ries. Dated October 18th, 1899. An electrolier has an inner tube, sliding in a fixed tube, and provided with a pin to engage recesses in the fixed tube, for supporting the inner tube at any height. The inner tube is lined with insulating material, and the space within it is divided by an insulating partition into two channels, each containing a straight bare wire. These wires pass through bare loops formed laterally on the ends of the insulated supply wires sliding connections being thus provided. 2 claims.

20,906. "Improvements in trolley standards used on cars or wagons electrically propelled from an overhead wire." E. M. Munro, W. Wood, H. Bracknell, H. I. Rogers. Dated October 19th, 1899. The trolley arm is clamped in a lever which is pivoted in the swivelling head of the standard, and this lever is connected by a pivoted link to a plunger between which and a collar fixed in the tube attached to the head lies a spring or springs. As the trolley arm is turned down the differing tension in the spring is compensated for by the varying leverage of the lever. A conductor passes through the poles and standard. A stop is provided near the ball race to prevent a complete revolution, and a stop prevents the tube from being withdrawn. A hinged cap having a peak excludes rain and dust. 2 claims.

20,883. "Improvements in trolleys used on overhead wires for electric traction." W Wood. Dated October 20th, 1899. The spindle for the wheel of the trolley described in Specification No. 28,839, A.D. 1897, is now made hollow with one or more chases for holding and distributing lubricant. A pin holds the spindle and screw caps close its ends. 1 claim.

20,886. "Improvements in machines for and the method of making electrodes for storage batteries." W. W. Hanscom and A. Hough. Dated October 20th, 1899. Relates to a machine for forming pellets or discs of active material. The machine comprises a mould, having a perforated bottom, and in this mould is placed the material to be acted upon, which consists of lithage moistened with a solution of sugar and sal-ammoniac. The pellet is compressed by a plunger, which is forced downwards by a screw operated by a hand-wheel. The plunger is provided with pins which perforate the material before it is compressed, and also pass into the perforations in the bottom plate. The face of the plunger is formed by a plate which slides on the pins and is connected to a rod having a head, so that, after the compressing operation, the disc of active material is removed from the pins by forcing down the plate by means of the threaded rod, which is operated by the hand-wheel. A number of the perforated discs so formed are placed together, and have a wire wound continuously around them, after which they are reduced to spongy lead in a suitable electrolytic bath. The discs of spongy lead are then reduced to ordinary lead by the pressure of a roller on their edges while they are rotating on a mandrel. The discs are then arranged and a connecting-frame of lead is cast around them. 8 claims.

21,076. "Improvements in electric cells or batteries." B. Willcox. (Columbus Electricitats-Gesellschaft, Gesellschaft mit Beschrankter, Haftung.) Dated October 21st, 1899. Relates to wet or dry batteries wherein calomel (mercurous chloride) is intimately mixed with carbon is employed as a depolarising agent, and consists in mixing with these bodies an electrically indifferent, neutralising body, such as powdered chalk, to avoid the formation of free hydrochloric acid in the depolariser. As the mercury formed during the action of the battery remains enclosed in the carbon in the condition of very finely divided metal, the cell may be regenerated by means of a current supplied from an external source. Reference is made to Specification No. 6,876, A.D. 1884. 1 claim.

21,079. "Improvements in time indicators for use in connection with a telephonic service." R. W. J. Sutherland. Dated October 21st, 1899. Clocks and watches for timing telephone conversations. An extra dial, preferably divided to show a short duration, such as six minutes, is provided with a hand capable of making one revolution. The hand is attached to a spindle carrying a toothed or friction bevel-wheel capable of being brought into gear or released from the driven bevel-wheel. The spindle carries pins or has a groove for the returning spring, by which the bevel-wheels are normally held out of gear. The levers enable the wheels to be brought into gear. The shaft also carries a notched disc, against the face of which a pawl on the spring engages while the wheels are in gear. The pawl engages in a notch by the action of the spring on the completion of one revolution. As applied to a watch, the extra hand may be arranged as a centre second hand. 2 claims.

21,082. "Improvements in electric circuit breakers." G. Wright. Dated October 21st, 1899. (Date under International Convention, March 23rd, 1899.) Relates to an overload magnetic cut-out, having knife-edge bearings. This specification is too complicated for purposes of abridgment. 3 claims.

21,083. "Improvements in controllers for electric motors." H. P. Davis and G. Wright. Dated October 21st, 1899. (Date under International Convention, March 24th, 1899). Consists of apparatus which operates with a predetermined rapidity which is independent of the character of the impulse imparted by the operator. Upon a base are mounted contact-pieces constituting the stationary terminals for the electric circuits adapted to engage contact-pieces mounted upon a non-conducting drum, which is rotatable for effecting the circuit changes necessary for the control of the motor. This drum is provided with metallic ends, mounted loosely upon sleeves which are also loosely mounted upon the shaft and are connected by a spiral spring. At one end of the shaft is fixed a collar which carries the operating hand-wheel or the like, and two arms with projections for engaging the standards and thereby limiting the rotation of the shaft. In operation, the controller being in zero or "off" position, when the shaft is rotated in, say, the clockwise direction, an arm of a cam fixed to the shaft engages a lug on the sleeve, and the other sleeve being retained by the drum, winds up the spring. The arm of the cam then moves a roller on a spring-pressed pawl, out of an engagement with a notch in the drum end, and liberates the drum, which thereupon turns at an indefinite speed determined by the strength of the spring and the adjustment of a dash-pot operated by levers and a cam on the other end of the shaft. The contacts corresponding to the initial speed of the motor are thereby quickly engaged, and the further movement of the drum to engage the contact-pieces corresponding to the maximum speed of the motor is then slowly effected at a speed controlled by the dash-pot mechanism. The shaft sleeves and drum end are fitted with suitable lugs for effecting the above-described operations in the opposite direction. For direct currents, a modified arrangement is described in which the drum end is provided with two retaining notches in order that the drum may be stopped at such a position as to avoid short-circuiting the motor armature when thrown from either "on" position to the "off" position. 8 claims.

21,084. "Improvements in mechanically-operated locks, suitable for safety lamps and other purposes." H. Mandt. Dated October 21st, 1899. Relates to a magnetically-operated lock for miners' safety lamps and for other purposes, and refers to Specification No. 12,870, A.D. 1893. The upper part of the lamp is screwed to the oil receiver, and is provided with a hasp, which is secured to a lock housing on the receiver by means of a bolt. This bolt is passed through slots in the hasp and housing, and is locked by spring pins entering it from opposite sides. The pins can only be withdrawn by the use of two magnets or by a key formed of two magnets suitably mounted on a cross-bar provided with a handle. The housing may be extended so as to enclose the pins completely, even when withdrawn from the bolt, and a thin plate may close the holes for the pins, in order to prevent surreptitious unlocking. 1 claim.

21,219. "Improvements in electric cut-outs and in electric switch devices applicable to and serving as holders therefor." J. Sachs. Dated October 24th, 1899. The fuses are enclosed in cases having the ends filled in with blocks of insulating material, through which the terminal pins pass and hold in position when disruption takes place. The pins and sockets, or the like, are made in standard sizes, corresponding to the fuse wires. The fuses may be coated with, or embedded in, a mass of deoxidising or combining material, such as borax or sal-ammoniac, contained in a tube, so that on disruption there is no danger of arcing, &c. The cases may also be partly filled with an elastic or compressible material, to reduce the effect of an explosive disruption, or a metal plate may rest against the pins. Several fuses may be mounted upon one pair of pins. These fuses may be fitted in switches. The fuses are removably connected to a block, and have flat perforated terminals adapted to engage with fixed terminals. The terminals have indentations, which serve as pivots. 21 claims.

21,276. "Improvements in magnetic separators." W. Clark. (C. F. Courtney.) Dated October 24th, 1899. A magnetic separator which may be used for treating ores or mixtures in a wet state, is provided with two pairs of coils within which rotate the cores connected by bars of soft iron. The lower pair of cores is driven by means of gearing, and the upper ends of these cores pass through stuffing boxes. The opposed ends of the cores are formed in one with heads or discs to which conical blocks made of non-conducting material are secured by screws. Pole-pieces are secured to the heads respectively, and are arranged upon the blocks in a helical manner. If desired, the pole-pieces may be formed upon rings shrunk on the cores. These pole-pieces taper towards their extremities, and they may be partially embedded into recesses formed in the blocks or in white metal. The coils are so connected that the polarities of the heads of each drum are opposite. The material to be treated is fed from a hopper provided with a distributing roller and a shoot, and the separated magnetic material is swept by brushes into a receiver; the non-magnetic material falls into a second receiver. The apparatus is fitted within a water-tight casing. 2 claims.

21,302. "Improvements in or connected with electricity measuring instruments." C. Sondermann and R. Berlow. Dated October 25th, 1899. In a galvanometer a vertical axle is suspended by a silk fibre from a head adjustable horizontally by three screws, and carries a thick iron block having two rounded sides and vertical sharp ends; this is situated between the poles of a permanent controlling magnet, and is deflected by two short straight electro-magnets, the coils of which carry the currents to be measured. The pole-faces of the electro-magnets are oblique or elliptically curved horizontally. At its lower end the axle passes through a sleeve adjustable horizontally by three screws and vertically by a yoke and another screw, and carries a spring supporting damping blades in a vessel containing oil. This may be closed by a conical valve on the spring. The axle also carries a horizontal cam, graduated in amperes and balanced by a bent arm on which two weights are screwed. The integrating apparatus contains a bell-crank lever, a horizontal arm of which is periodically raised by a star-wheel rotated uniformly by a clock; in the intervals a vertical arm of it bears against the cam. The bell-crank lever is connected by wires with a weight in an oil pot, and with a counter-weighted pawl lever, co-axial with a ratchet-wheel, which is driven by the pawl during the movements of the bell-crank lever, towards the cam. A stop limits the upward movement of the pawl lever. The ratchet-wheel is geared to a counter. The meter may be used with alternating-currents, and with more than two conductors. 2 claims.

21,311. "Improvements in an apparatus for exhibiting electric signals, advertisements and the like." A. J. Boult. (F. Y. Dalziel.) Dated October 25th, 1899. Signals, marine and other, and advertisements, consisting of letters, numerals or geometric or other figures formed of electric incandescent lamps arranged in a frame, &c., are lighted by means of a switch. The separate discs, which together form a rotary drum actuated by a handle and worm gearing, are each provided with grooves to receive conducting-blocks provided with projections and depressions so as to make contact with the desired terminals to light the particular lamps, the drum being sub-divided into as many discs as there are different representations to be made. 5 claims.

21,329. "Means of maintaining and renewing the charge of electric accumulators working motors for carriages, boats, balloons and other vehicles." P. E. Raoet Dated October 25th, 1899. (Date under International Convention, May 27th, 1899). A dynamo of low voltage, such as used for electrolysis, and driven by a motor worked by petroleum, alcohol, acetylene, hot air, ammonia, fusing powders, &c., is used to maintain and renew the charge of accumulators working motors of carriages, vehicles, boats, balloons and flying machines. The parts of the dynamo and motor are of aluminium or alloys of chromium, and the motor and dynamo are mounted on springs. 1 claim.

21,354. "Improvements in apparatus for electrically winding up, or giving tension to, driving springs." H. Aron, Ph.D., and Aron Electricity Meter, Limited. Dated October 25th, 1899. Relates to improvements in the mechanism for winding up, or giving tension to, driving springs, described in Specification No. 24,876, A.D. 1894. The arm carried by the swinging armature, and insulated from it, is provided with two pins. The driving spring is connected to one pin and conveys the current from the energising coil. The other pin makes and breaks the circuit. An adjustable cylinder, fixed by a screw, serves to adjust the tension of the spring and thereby control the play of the return stroke of the armature. 2 claims.

21,355. "Improvements in apparatus for measuring multiphase electric currents." H. Aron, Ph.D., and Aron Electricity Meter, Limited. Dated October 25th, 1899. Energy meters.—Work supplied on a four-wire three-phase alternating system is measured by a pendulum or motor meter in either of two ways, modified from that described in Specification No. 21,854, A.D. 1891. The mains may be connected in any way and unequally loaded. In one arrangement the three principal mains contain stationary coils, A, B, C, influencing two pendulums, which carry coils connected between the mains, A, B, and the fourth or "neutral" main, D; the effects of the coils, A, B, on the pendulums are summed, but the middle coil, C, is placed and connected so that it reduces the effects of both coils, A, B. A similarly-connected motor meter has two commutator armatures, carrying pressures, and mounted on one spindle or connected to separate counters; the magnetic fields are produced by magnets having coils in the mains, A, B, each magnet having also a second coil in the main, C. In the other arrangement, the pendulum coils, E^2, E^1, are connected between two principal mains, A, B, and the third one, C, and the stationary coils are in the mains, A, B, and the "neutral" main, D; the coil D is placed at a distance such that it has one-third of the effect of either coil, A, B, on the pendulum, E^2 or E^1, respectively. In this arrangement, the meter registers the difference of the effects of the coils, A, B, on the pendulums, and the coil, D, increases both these effects. 4 claims.